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Vol. 65 APRIL, 1938 No. 4

Bulletin

of the

Torrey Botanical Club

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Published for the Club monthly except
July, August, and September
by
GEORGE BANTA PUBLISHING COMPANY, MENASHA, WISCONSIN
Subscription price $6.00 per year

Entered as Second Class Matter at the Post Office at Menasha, Wisconsin
Accepted for mailing at special rate of postage provided for in the act of February 28, 1925, embodied in paragraph 4, section 412, P. L. and R., authorized July 23, 1928.

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Bulletin. Established 1870. Monthly, except during July, August, and September. Price, $6.00 a year; single numbers 75 cents. Of former volumes, only 24-56 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to Dr. R. P. Wodehouse, 75 Ridge Drive, Yonkers, N.Y. The editors may accept papers up to 20 pages in length, with illustrations and tabular matter generally not exceeding twenty per cent of that amount. Longer and more copiously illustrated papers, however, may be published if the excess pages, illustrations, and tabular matter are paid for by the contributors. Claims for missing numbers should be made to the Treasurer within 60 days following their date of mailing. The Treasurer will supply missing numbers free only when they have been lost in the mails.

Torreya. Bimonthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Mr. George T. Hastings, Editor, 2587 Sedgwick Ave., New York, N.Y.

Memoirs. Occasional, established 1889.

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00.

Reprints. Contributors of articles accepted for publication in the BULLETIN should order reprints, if desired, when they return galley proofs to the editor. They may be ordered through the editor from the George Banta Publishing Company, the contributor paying for all his reprints. A schedule of rates is sent with galley proof.

Studies in Onagraceae XI. A revision of the genus Gaura

PHILIP A. MUNZ

(*concluded*)

11. GAURA BRACHYCARPA Small, Flora S.E. U. S., 848, 1335. 1903.

Apparently a winter annual, branched at base, the stems simple or again branched, very slender, decumbent, 1–3.5 dm. long, finely hirsute in leafy part; rosette-leaves oblanceolate, 4–6 cm. long, remotely sinuate-dentate, obtuse, gradually narrowed into short winged petioles, somewhat villous; cauline leaves on lower half of stems, the blades thin, mostly lance-ovate, sinuate-denticulate to subentire, 1.5–4 cm. long, 5–12 mm. wide, acute to obtuse, somewhat cuneate, sparsely villous, sometimes linear-lanceolate; spikes few-flowered, slender, strigulose, somewhat peduncled, nodding at tip, 5–20 cm. long; hypanthium strigulose, slender, 4–7 mm. long, copiously white-pubescent within; sepals 6–8 mm. long, strigulose, linear, reflexed separately in anthesis; petals white, aging pink, spatulate, 6–8 mm. long; stamens subequal, filaments flattened, 4-5 mm. long, with basal scale; anthers reddish, ca. 2 mm. long; style pubescent at base, somewhat surpassing stamens; stigma-lobes about two-thirds mm. long; capsule elongate-pyramidal, 5–7 mm. long, subglobose, flat at base, 4-angled, the angles auricled at base, the faces transversely wrinkled; seeds few.

Type locality, San Diego, Texas. Ranging rather widely in eastern Texas. Representative material, TEXAS: Dallas, *Reverchon in 1874* (G); 6 mi. northwest of Valley Springs, Llano Co., *Cory 6269* (P); San Marcos, Hayes Co., *Stanfield in 1897* (NY); West Cave, Blanco Co., *Bogusch 713* (US); San Antonio, *Jermy 254* (NY), *Clemens 687* (P); Sutherland Springs, Wilson Co., *Jones in 1932* (P); Corpus Christi, Nueces Co., *Heller 1391* (G, NY, US); Kingsville, Kleberg Co., *Jones 29568* (P); Sabinal, Uvalde Co., *Jones in 1932* (P); Carrizo Springs, Dimmit Co., *Jones 28141* (P) Laredo, Webb Co., *Palmer 11264* (G, NY, US); San Diego, Duval Co., *Croft 109*, type (NY).

This species is characterized by its slender decumbent stems, its strigulose buds, and pyramidal auricled fruit.

12. GAURA TRIPETALA Cav., Icones **4**: 66, pl. 396. 1797.

Apparently annual to short-lived perennial, usually branched from base stems rather slender, simple or branched, ascending, hirsute, often reddish, 2–6 dm. long; basal leaves oblanceolate, sinuate-dentate, 4–8 cm. long, narrowed into short winged petioles, more or less pubescent, especially on veins and margins; cauline leaves lanceolate to oblong-linear, entire to sinuate-

[THE BULLETIN FOR MARCH (**65**: 135–209) WAS ISSUED MARCH 1, 1938]

dentate, sometimes wavy, almost or quite sessile, 2–5 cm. long, almost glabrous to pubescent, acuminate to obtuse; spikes 1–3 dm. long, somewhat peduncled; hypanthium 4–5 mm. long, slender, often reddish, pubescent within; sepals 3, narrow, 4–6 mm. long, usually distinct in anthesis; petals 3, oblanceolate, 3–4 mm. long, red in age; stamens 6, subequal; filaments 3–4 mm. long; anthers often red, 1–1.5 mm. long; style pubescent at base; capsule ovoid-pyramidal, sharply 3-angled, 4–8 mm. long, each face with median rib and transverse wrinkles.

KEY TO VARIETIES

Inflorescence glandular-pubescent. Hidalgo to Puebla.....12a. *G. tripetala* var. *typica*
Inflorescence not glandular.
Buds strigose. Texas to Durango.....12b. *G. tripetala* var. *Coryi*
Buds glabrous. Oklahoma.....12c. *G. tripetala* var. *triangulata*

12a. **Gaura tripetala** Cav. var. **typica** n.nom.

G. tripetala Cav., Icon. **4**: 66, pl. 396. 1797. *G. hexandra* Ortega, Hort. Matr. Dec., 14, 1797; Sessé & Moc., Pl. N. Hispan., ed. 1, 56. 1887–'90.

Inflorescence, hypanthium, calyx and ovary glandular-puberulent.

Type locality, "Prope Pachuca et San Agustin," Hidalgo, Mex. Ranging in central Mexico. Material seen, WITHOUT LOCALITY: G. tripetala ex herb. Madrid, A. Gray, 1880 (G); Jard. des Plantes, in 1815 (G); Mexico, *Ruiz* (Ber, photos at G, P); G. hexandra, *Sessé, Mociño, Castillo, & Maldonado 5147 & 936* (Madrid) FEDERAL DISTRICT; Tultenango, *Rose & Painter 7840* (US); Eslava, *Rusby 123* (NY), *Rose & Painter 7145* G, US); valley of Mexico, *Pringle 9795* in part (G, US); Tolucca, *Berlandier 1099* (US); Ixtaccihuatl, *Purpus in 1903* (US). PUEBLA: Rte. de Cholula, Puebla, *Arsène 900* (NY, US); Cerro et fort de Guadelupe, *Arsène in 1908* (NY, US); Laguna de San Baltasar, *Arsène 1113* (US).

12b. **G. tripetala** Cav. var. **Coryi** n.var.

Hypanthium, sepals, usually ovaries strigulose. (Hipantium, sepala, et plenunque ovaria strigulosa).

Type, dry banks, Hempstead, Waller Co., Texas, *E. Hall 211*, April 25, 1872, Pomona College Herbarium No. 39283; isotypes (G, NY, US). Texas and northern Mexico. Representative material, TEXAS: without locality, *Wright 205* (G, US), *Drummond III, 82* (NY); Bryan, Brazos Co., *Palmer 7794* (NY, US); Encino (Encinal?), La Salle Co., *Jones 29567* (P); near San Angelo, Tom Green Co., *Cory 8824* (P); Olney, Young Co., *Cory 13142* (P). MEXICO: without locality, *Coulter 163* (G); Aguascalientes, *Rose & Painter 7786* (NY, US); Saltillo, *Gregg 29* (G); La Quemada, Zacatecas, *Seler 4790* (G); Durango, *E. Palmer 257*, in 1896 (G, NY, US). It is a pleasure to name this new variety for my friend Mr. V. L. Cory of

Sonora, Texas, who has done so much interesting work in recent years on the flora of his state.

12c. **Gaura tripetala** Cav. var. **triangulata** (Buckl.) n. comb.

G. triangulata Buckl., Proc. Acad. Sci. Philad. **1861**: 454. 1862.
Hypanthium, calyx, and ovaries glabrous.

Type locality, "Prairies Northern Texas," May, S. B. Buckley. I have seen the following material, OKLAHOMA: Cache, Comanche Co., *Stevens 1325* (G, NY); Ft. Sill, Domanche Co., *Clemens 11709* (G); Catoosa, Rogers Co., *Bush 1131* (NY); Oklahoma City, *Carleton 129* (US). An intergrade with var. *Coryi* is: 15 miles east of Tulsa, *Engelman in 1935* (P).

I am indebted to Dr. Francis Pennell of the Philadelphia Academy for examining and reporting to me on the glabrous condition of Buckley's type.

I should add, before going on to the next species, that I have some misgiving as to the recognition of *Gaura tripetala* as a species. Its chief claim to specific rank is its tripetalous and trisepalous condition. But after studying *G. angustifolia* and finding flowers on the same plant built on both the plan of 3 and that of 4, I am somewhat dubious as to the value of this character. Furthermore, some sheets referred to *G. tripetala* seem more like one species, others like another. For example, *Palmer 257* from Durango seems very much like *G. gracilis*, while most Texas plants are more like *G. brachycarpa*. I am therefore not at all sure that all are conspecific. However, since in Texas and Mexican material I have seen no such variation in number of floral parts as in the Florida species *angustifolia*, and since without much cytological and garden evidence, further status cannot be determined, I am forced for the present to recognize *G. tripetala*.

13. GAURA VILLOSA Torr., Ann. Lyc. N.Y. **2**: 200, 1828.

Perennial, usually suffrutescent, stems several from base, ascending-erect, mostly 5–10 dm. tall, with several divergent lateral leafy branches closely placed and at a distance of 2–3 dm. above the base, often with another similar umbellate group further up the stem; stems canescent or rather stiffly appressed-villous; leaves numerous, crowded, canescent, appressed-villous, more or less undulate, the lower ones spatulate to ovate or lanceolate, mostly sinuate-serrate or -denticulate, acuminate to obtuse, 3–7 cm. long, 8–25 mm. wide, narrowed at base, subsessile or short-petioled, upper ones linear to lance-ovate, 1.5–2 cm. long, 3–15 mm. wide; floral bracts ovate to ovate-lanceolate, 1–3 mm. long caducous, pubescent at least on the margins; inflorescence 3–6 dm. long, open, branched, with very slender stems, scarcely peduncled, the branches subglabrous, occasionally cinereous-strigulose; hypanthium funnelform, 2 mm. long, with dense white curly pubescence within; sepals lance-

linear, 7–10 mm. long, separate in anthesis; petals white, turning red, ca. 8 mm. long, broadly elliptic, abruptly narrowed into slender claw ca. 2 mm. long; stamens subequal, filaments 8–9 mm. long, slightly enlarged upward; anthers 2–3 mm. long, red; style slightly exceeding stamens, pubescent at base; stigma-lobes ca. 0.3 mm. long; capsule usually finely puberulent, sometimes subglabrous, the body oblong, wing-angled, somewhat narrowed toward summit, 7–9 mm. long, 2–3 mm. wide, rather abruptly narrowed into a very slender stipe-like base 3–6 mm. long.

KEY TO VARIETIES

Hypanthium and sepals cinereous-strigulose.
Ovary cinereous-strigulose; leaves canescent-villous. Kansas to Texas. . . . . 13a. *G. villosa* var. *typica*
Ovary quite glabrous except for few hairs near the summit. So. Texas. . . . . 13b. *G. villosa* var. *McKelveyae*
Hypanthium, sepals and ovary with short spreading hairs.
Hairs of hypanthium, etc not gland-tipped. So. Texas. . . . . 13c. *G. villosa* var. *Parksii*
Hairs of hypanthium, etc. gland-tipped. Western Texas & E. New Mex. . . . . 13d. *G. villosa* var. *arenicola*

13a. **Gaura villosa** Torr. var. **typica** n.var.

G. villosa Torr., Ann. Lyc. N. Y. **2:** 200. 1828. *G. cinerea* Woot. & Standl., Contr. U. S. Nat. Herb. **16:** 152. 1913.

Leaves canescent-villous, the lower lanceolate to spatulate, 8–15 mm. wide, the upper 3–5 mm. wide; hypanthium, sepals, ovaries cinereous-strigose.

Type locality, "Sources of the Canadian," the original collection by James. Range New Mex. and Kans to Texas. Representative material, NEW MEXICO: 20 miles south of Roswell, Chaves Co., *F. S. & E. S. Earle 533*, type coll., cinerea (NY, US); Santa Rosa, Guadalupe Co., *Degener 4803* (NY); sources of the Canadian, *James*, type villosa (NY). KANSAS: Morton Co., *Hitchcock 172* (G, NY, US); Arkalon, Seward Co., *Smyth 157* (NY, US); Coldwater, Comanche Co., *Rydberg & Imler 678* (NY); Meade, Meade Co., *Smyth in 1890* (NY). OKLAHOMA: False Washita, bet. Ft. Cobb & Ft. Arbuckle, *Palmer 137* (NY, US); Alva, Woods Co., *Stevens 773* (G, NY, US); Clinton, Custer Co., *Palmer 12549* (G, NY, US); Bridgeport, Caddo Co., *Munz 13576* (P). TEXAS: Seymour, Baylor Co., *Reverchon 10* (G, NY); Estelline, Hall Co., *Reverchon 4306* (G, P, US); Posey Canyon, Lubbock Co., *Demaree 7767* (G); 16 miles no. of Matador, Motley Co., *Cory 16046* (P); near Wellington, Collingsworth Co., *Cory 16144* (P).

13b. **G. villosa** Torr. var. **McKelveyae** n.var.

Strictly herbaceous; stems decumbent, then ascending, 3–5 dm. long; leaves deeply and regularly sinuate-dentate, oblong-lanceolate to oblanceolate

in outline, sparsely villous, about as wide as in *typica*, but seeming narrower because of the deeper dentation; hypanthium and sepals cinereous-strigulose; ovary usually glabrous except for a few hairs near the summit. (Planta herbacea; caulibus decumbentibus, tunc ascendentibus, 3–5 dm. longis; foliis sinuato-dentatis, parce villosis; hipantio sepalisque cinereo-strigulosis; ovario plerumque glabro, cum capillis paucis supra.)

Type, near Mathis, San Patricio Co., Texas, April 5, 1931, *Susan Delano McKelvey 1718*, Gray Herbarium; isotype Pomona 186535. Other material seen, TEXAS: Corpus Christi, *Tracy 9273* (G, NY, US); Hidalgo Co., *Runyon 153* (US); near Brownsville, Cameron Co., *Townsend 32* (US). It is a great pleasure to name this very distinct, more herbaceous, less villous local plant of extreme southern Texas for Mrs. McKelvey, whose collections of Onagraceae from Texas have been of great help to me.

13c. **Gaura villosa** Torr. var. **Parksii** n.var.

Leaves densely soft-silky, lanceolate to ovate, the lower 10–25 mm. wide, the upper 5–15 mm. wide; hypanthium, sepals, and ovary with dense grayish short spreading hairs. (Folia sericea, lanceolata aut ovata, infimis 10–25 mm. latis, superioribus 5–15 mm. latis; hipantio, sepalis, et ovario cum capillis curtis et extensis.)

Type, sandy open places, Terrell Hill, near Kaicaster, Wilson Co., Texas, June 24, 1935, *P. A. Munz 13334* Pomona College Herbarium 212450; isotypes 212582, 212583, 212449. Other material seen, TEXAS: sandy plains of the Nueces, *Wright in 1848* (G); Stonewreath Hills, Lower Rio Grande, *Schott* (NY); 17 miles so. of San Antonio, *Metz 656* (NY); near Devine, Medina Co., *Cory 12736* (P); San Ygnacio, *Tharp 3622* (US); east of Carrizo Springs, Dimmit Co., *Jones 28140* (P).

This interesting variant was first pointed out to me in the field by Mr. H. B. Parks, botanist and entomologist of San Antonio, Texas, and I am very happy to name it for him.

13d. **Gaura villosa** Torr. var. **arenicola** n.var.

Leaves densely soft-silky, lanceolate to lance-ovate, 5–10 mm. wide; hypanthium, sepals, and ovary with short spreading gland-tipped hairs. (Folia sericea, lanceolata aut lanceo-ovata, 5–10 mm. lata; hipantio, sepalis et ovario cum capillis curtis, extensis et glandulosis).

Type, five miles northeast of Portales, Roosevelt Co., New Mexico, on sand dunes near Highway 33, June 14, 1930, *Goodman & Hitchcock 1124*, Pomona College Herbarium No. 171881; isotype at NY. Other material seen, NEW MEXICO: near Portales, *Wooton in 1909* (US). TEXAS: sand hills, 2 mi. so. of Muleschoc, Bailey Co., *Ferris & Duncan 3421* (NY);

Odessa, *Reed 1909* (US); 2 miles west of Bledsoe, Morton Co., *Cory 16528* (P) OKLAHOMA: Canadian River Valley, near Pack Saddle Bridge, Ellis Co., *Goodman 2591* (P).

14. GAURA FILIPES Spach, Nouv. Ann. Mus. Paris **4**: 379. 1835.

Perennial herb, branched from base, 5–18 dm. tall, ascending to erect, the stems puberulent, sometimes also hirsute, reddish, paniculately branched above; basal leaves not seen; cauline leaves numerous, crowded on lower parts of stem, linear to oblanceolate or lanceolate, usually sinuate-denticulate 3–6 cm. long, 3–15 mm. wide, acute to obtuse, narrowed at base, subsessile or short-petioled, subglabrous to strigulose, sometimes villous underneath on veins; upper leaves reduced, 0.5–2 cm. long, lance-linear, acuminate; floral bracts lance-linear, 3–5 mm. long, caducous; inflorescence open-paniculate, 2–5 dm. long, canescent-strigulose especially on the buds, scarcely peduncled or with peduncles 5–10 cm. long, the spikes on very slender axes; hypanthium gray-strigulose without, narrow-funnelform, 3–5 mm. long, white-puberulent within; sepals strigulose, lance-linear, 5–10 mm. long, reflexed separately in anthesis; petals white, turning rose, broadly oblanceolate, clawed, 4–6 mm. long; filaments subequal, slightly enlarged upward, 4–5 mm. long; anthers 1.5–2 mm. long; style pubescent at base, scarcely exceeding stamens; stigma-lobes 0.4–0.8 mm. long; capsule strigulose, obovoid-clavate, sharply 4-angled toward the summit, the body 4–5 mm. long, scarcely 2 mm. wide, gradually or rather abruptly narrowed into a very slender pedicel-like base 1–3 mm. long.

KEY TO VARIETIES

Sepals 5–7 mm. long; petals 4–5 mm. long ..... 14a. *G. filipes* var. *typica*
Sepals 8–10 mm. long; petals 6 mm. long ..... 14b. *G. filipes* var. *major*

14a. **Gaura filipes** Spach var. **typica** n.var.

G. filipes Spach, Nouv. Ann. Mus. Paris **4**: 379. 1835.
Flowers small; sepals 5–8 mm. long; petals 4–5 mm. long.

Type locality, Jacksonville, Fla. Range from So. Car. to Fla. Representative material, SOUTH CAROLINA: 25 miles west of Columbia, Lexington Co., *Munz 13359* (P); Aiken, *Ravenel* (NY, US); Clemson College, *House 2894* (US). GEORGIA: Cobb Co., *Wilson in 1900* (G, NY, US); Hogansville, Troup Co., *Wiegand & Manning 2166* (G). ALABAMA: Auburn, Lee Co., *Earle & Baker 1230* (NY, P); Mobile, *Mohr* (G). MISSISSIPPI: Meridian, *Schuchert in 1896* (US). FLORIDA: Aspalaga, *Curtiss 3929c* (G, NY, US); River Junction, Gadsden Co., *Nash 2578* (G, NY, US); Jacksonville, *Drummond*, apparently type coll. (G, K, photo at P); Lake City, *Nash 2498* (US).

14b. GAURA FILIPES Spach var. MAJOR Torr. & Gray, Fl. N. Am. 1: 517. 1840.

G. Michauxii Spach, Nouv. Ann. Mus. Paris 4: 379. 1835.

Flowers larger, the sepals 8–10 mm. long; the petals 6 mm. long.

Type locality, Kentucky, if we use as type the first specimen cited which was collected by Short. Specimens seen, INDIANA: 1 mi. west of Plainsville, Daviess Co., *Deam 47902* (G, US). TENNESSEE: Lookout Mt., *Biltmore Herb. 3929b* (G, NY, US); Cowan, Franklin Co., *Biltmore Herb. 3929a* (G, NY, US). KENTUCKY: Barrens of Ky, *Short*, type (NY). Without definite locality, "Chez les Cherokees, *Palisot de Beauvois*, type Michauxii (Del, photo at P). Material from Jackson Co., Fla., *Chapman* (NY) is quite intermediate in flower size with var. *typica*. A peculiar specimen ("On shell islands near Gulf," La., *Langlois 97* (NY) has capsule and stipe of *G. filipes* and flower-size of *G. Lindheimeri;* it may possibly be a hybrid of *Lindheimeri* and some other.

15. GAURA NEALLEYI Coulter, Contrib. U. S. Nat. Herb. 1: 38. 1890.

Apparently mostly biennial from a fleshy tap root, usually several-stemmed from base, sometimes simple; stems hirsute below, mostly simple, ascending to erect, 2–6 dm. high; basal leaves oblanceolate, sinuate-dentate, 5–15 cm. long, 8–18 mm. wide, quite glabrous except for the short stiff hairs on margins and beneath the midrib, narrowed gradually into a winged petiole; lower cauline leaves rather crowded, lanceolate, almost sessile, sinuate-dentate, acute, with pubescence of basal leaves, mostly 1.5–3 cm. long, 5–10 mm. wide; uppermost reduced and almost linear; floral bracts rounded-ovate, ciliate, 2.5–3.5 mm. long, caducous; inflorescence rather few-flowered, lax spicate, scarcely or short-peduncled, becoming 1–3 dm. long in fruit, subglabrous in lower parts, glandular-puberulent in upper parts and on hypanthium and calyx and ovary; hypanthium 8–12 mm. long, puberulent within; sepals 8–11 mm. long, reflexed separately in anthesis; petals whitish, aging red, broadly oblanceolate, 4–5 mm. long; stamens subequal; filaments 4–5 mm. long, somewhat flattened; anthers 2–3 mm. long; style exceeding stamens, puberulent at base; stigma-lobes ca. 0.6 mm. long: capsules ovoid-pyramidal, 8-9 mm. long, 2.5–3 mm. wide, rather sharply 4-angled, glabrous, each face with midrib and minute transverse wrinkles, the base abruptly narrowed into a thick stipe-like base 1–1.5 mm. long.

Type locality, Chenate Mts., Presidio Co., Texas. Range, western Texas and adjacent New Mexico. Material seen, TEXAS: Limpia Canyon, 12 mi. north of Ft. Davis, Jeff Davis Co., *Cory 9659* (P), Limpia Canyon, *Tracy 294* (G, NY), Limpai Creek, *Earle & Tracy 294a* (NY, US); Davis Mts., *Earle & Tracy in 1902* (NY); Old Ft. Davis, *Ferris & Duncan 2718*

(NY); Cibolo, *Havard in 1881* (US); Chenates region, *Nealley in 1889*, type (US); Kokernot Springs, near Alpine, Brewster Co., *Cory 9632* (P). NEW MEXICO: Dark Canyon, Guadalupe Mts., *Standley 40666* (US); Copper Mines, *Wright in 1851* (NY); El Capitan Mts., Lincoln Co., *F. S. & E. S. Earle 517* (NY, US).

This species is characterized by its hirsute stem, glandular inflorescence, and short stipe. It intergrades with *G. gracilis* f. *glandulosa* from which it is doubtfully distinct. For example, of the specimens above cited, *Cory 9632* approaches the latter in its very short stipe; *Long 7437* (US) from Sandia Mts., New Mex. has the short stipe of *gracilis* but the flowers of *Nealleyi*. *Nelson 3913* (US) from La Ventura, Coahuila has the flower size of *Nealleyi* but the strigulose fruit of typical *gracilis*.

16. GAURA SINUATA Nutt., ex Seringe, in DC., Prodr. **3**: 44. 1828.

Perennial herb, 3–8 dm. tall, the stem simple or more generally with several ascending branches from above the base, glabrous or nearly so; basal leaves oblanceolate to oblong-lanceolate, subglabrous, or puberulent especially on the edges, 3–8 cm. long, 1–2 cm. wide, sinuate-dentate, obtuse to acute, with short winged petioles; cauline leaves rather crowded, spatulate to lanceolate, even linear, sinuate-dentate to almost entire, often wavy, subglabrous to strigulose, 1–5 cm. long; floral bracts 1–3 mm. long, caducous, lanceolate to ovate with narrow tip, subglabrous or with few short hairs on margins; inflorescence simple or branched, 2–5 dm. long, with naked peduncles 1 or more dm. long; hypanthium 2.5–3 mm. long, subglabrous or sparsely strigulose, narrow-funnelform, white-pubescent within; sepals grayish-strigulose, 7–10 mm. long, narrow, separately reflexed in anthesis; petals white, becoming red, 8–10 mm. long, broadly elliptic, the claw rather narrow, ca. 2 mm. long; filaments subequal, slightly enlarged upward, 8–10 mm. long; anthers reddish 3–3.5 mm. long; style somewhat longer than stamens, puberulent at very base; stigma-lobes about 0.5 mm. long; capsule nearly or quite glabrous, the body fusiform, obtusely 4-angled, 5–9 mm. long, 1–1.5 mm. wide, gradually tapering into rather thick pedicel-like base 2–5 mm. long.

Type locality, "In Arkanza et Red-River," probably in Okla. Ranging from Okla. to northern Mexico. Representative material, Arkansas & Red River, *Nuttall in 1825*, type coll. (Del), Arkansa, *Nuttall* (Kew, photo at P); Red River, *Nuttall* (NY). OKLAHOMA: Mountain Park, Kiowa Co., *Stevens 1218* (G, P); Granite, Greer Co., *Stevens 999* (G, NY, US); Mannsville, Johnston Co., *Griffith 3491* (G, NY); Norman, Cleveland Co., *Middleton in 1935* (P). TEXAS: Texas III, *Drummond 76* (G, NY); Chillicothe, Wilbarger Co., *Ball 961* (NY, US); Ft. Worth, *Ruth 37* (G, NY, US); Dallas, *Reverchon*, Curtiss distrib. 896 (G, NY); Mertzon, Irion Co., *Palmer 12415* (G, NY, US); Comanche Spring, *Lindheimer 800* (G, US);

Kerrville, Kerr Co., *Heller 1692* (G, NY, US); New Braunfels, *Lindheimer 802* (G, NY, US); New Hempstead, Waller Co., *Hall 214* (G, NY, P); Carrizo Spring, Dimmit Co., *Jones 28145* (P); Refugio, Refugio Co., *Benke 5401* (P); Limpio, *Wright in 1851* (G); Kingsville, Kleberg Co., *Tracy 9275* (NY, US); Diversion Lake, Archer Co., *Cory 13222* (P). COAHUILA: Diaz, *Pringle 8320* (G, NY, P. US); Saltillo, *Palmer 233* (G, NY, P, US); Sabinas, *Nelson 6810* (US). TAMAULIPAS: Cerro del Chino, Sierra de San Carlos, *Bartlett 10717* (US).

This species is characterized by its slender, pedicelled glabrous fruit. It is becoming naturalized out of its original range, as for example, So. Car., Charleston, *Robinson 196* (G); Tuscaloosa, Ala., *Harper 3192* (NY, US); San Dimas, Los Angeles Co., California, *Wheeler 947* (P); junction Los Troncos and San Francisco Creeks, San Mateo Co., Calif. *Abrams 13687* (P).

17. GAURA ODORATA Sessé ex Lagasca, Gen. et Spec. Pl., 14. 1816.

Schizocarya Drummondii Spach, Nouv. Ann. Mus. Paris IV, **3**: 382. 1835. *Gaura Drummondii* T. & G., Fl. N. Am. **1**: 519. 1840; D. Dietr., Syn. Pl., 1297. 1840. *G. hispida* Benth., Pl. Hartweg., 288. 1840.

Apparently biennial or winter annual, mostly branched at base, the stems ascending, 2–5 dm. high, rather slender, simple or few-branched, grayish pubescent, the hair appressed or spreading but usually not over 1 mm. long; basal leaves apparently oblanceolate, sinuate-dentate; lower stem leaves lanceolate to ovate or oblanceolate, 2–5 cm. long, 5–15 mm. wide, sinuate-dentate, acutish at both ends, scarcely petioled, rather crowded, gradually reduced upward and becoming lance-linear, strigulose; floral bracts lance-ovate, acute, 3–6 mm. long, strigulose, caducous; spikes sessile or short-pedunculate, with nodding tips, 1–3 dm. long in fruit, mostly strigulose; petals oblong-lanceolate, 8 mm. long, white to pink, turning red; stamens subequal, filaments flattened, 5–6 mm. long; anthers reddish, ca. 4 mm. long; style well exserted beyond stamens, pubescent at base; stigma-lobes ca. 1 mm. long; capsule glabrous to strigulose, 8–11 mm. long, the lower third terete, gradually enlarged upward, the upper two-thirds ovoid-pyramidal, acute, rather sharply 4-angled, each face ca. 2.5 mm. wide, with median nerve; seeds up to 4.

Type locality, "Habiat in Nova Hispania." Ranging from Texas to central Mexico. Representative material, TEXAS: Ft. Worth, *Ruth 276* (NY); Comanche Spring, *Lindheimer 41* (G); Temple, Bell Co., *Wolff 3016* (US); San Felipe de Austin, *Drummond 36*, type coll. Drummondii (G, NY, K, photo at P); Austin, *Hall 213* (G, NY, P, US); near Roosevelt, Kimble Co., *Cory 18969* (P); San Antonio, *Heller 1590* (G, NY, US); Bracken, Bexar Co., *Groth 146* (G, NY, US); Uvalde, *Palmer 13530* (US); San Diego, Duval Co., *Croft 111* (NY). TAMAULIPAS: Matamoros,

Berlandier 2313 (G). NUEVO LEON: Monterey, *Dodge 110* (US). COAHUILA: Saltillo, *Palmer 23* (G, NY, US); DURANGO: Durango, *Palmer 94* (G, NY, US). GUANAJUATO: Leon, *Hartweg 1603*, type hispida (K, photo at P). SAN LUIS POTOSI: Guascama, *Purpus 5383* (G, NY, US). MICHOACÁN: Morelia, *Arsène 2752* (G, US). QUERÉTARO: Querétaro, *Arsène 10599* (G,US). HIDALGO: Ixmiquilpan, *Rose, Painter and Rose 9079* (G, US). PUEBLA: San Luis Tultitlanapa, *Purpus 3387* (G, NY, US). OAXACA: Distr. Etla, *Seler 83* (G, US); Huitzo, *Rose & Rose 11364* (G, NY, US). Without locality, "G. odorata Lag., Hort. veg. Matrit 1814? Reuter (Boissier)."

I am unable to separate plants with hirsute stems from those without; nor can I find any other definite characters by which *G. hispida*, for instance, can be segregated from the other material. Plants from the more southern and western parts of the range seem to have more pubescence on the fruits than do others. The species is with some difficulty separable from all forms of *G. coccinea*, which also has the thick base to the fruit, but I believe the larger flowers and more early shedding of the floral bracts, as well as usually longer fruits generally distinguish the two.

18. GAURA COCCINEA Nutt. ex Fraser's Cat., 1813 as nomen nudum; ex Pursh, Fl. Sept. Am. **2**: 733. 1816; Nutt., Gen Am. **1**: 249. 1818.

Perennial herb; stems several, simple or branched, ascending, 1–5 dm. high glabrous to strigose and hirsute; leaves numerous, mostly sessile, the lower oblanceolate to broadly or narrowly lanceolate or oblong, 1.5–3.5 cm. long; main ones oblong-lanceolate to almost linear; uppermost linear to lance-linear; leaves canescent to glabrous; floral bracts linear to lanceolate, 3–6 (11) mm. long, persistent; spikes simple, sessile or short-peduncled, becoming 5–18 cm. long, nodding at tips; hypanthium narrow-infundibuliform, 5–8 mm. long, strigulose without, puberulent within; sepals oblong-linear separately reflexed in anthesis, 5–8 mm. long; petals whitish to pink or red, aging red, 3–6 mm. long, broadly elliptic with narrow claw; stamens subequal; filaments 4–5 mm. long, white to yellowish, somewhat flattened upward; anthers yellow or red, 2–5 mm. long; style slightly exceeding stamens, pubescent at base; stigma-lobes suborbicular, ca. 0.25 mm. long; capsule 5–10 mm. long, 1.5–3 mm. thick, sessile, the body proper 4-angled. tapering toward the tip in pyramidal fashion, abruptly constricted toward the gradually narrowed but stout terete base.

KEY TO VARIETIES

Capsule 5–7 mm. long, 2.5–3 mm. wide; anthers 2–3 mm. long.
Stem and leaves more or less pubescent.
Leaves (at least the lower) lanceolate and sinuate-dentate.
Main leaves mostly plane, oblong, crowded; flowers crowded; inflorescence not peduncled; plant 1–3 dm. high. Ariz. and New Mex. northward. . . . . 18a. *G. coccinea* var. *typica*

Main leaves mostly waved and crisped, acutish, not crowded; flowers not crowded; inflorescence with short peduncle; plant 3–4 dm. high. Ariz. and Texas to Mexico.... .....18b. *G. coccinea* var. *epilobioides*

Leaves linear, subentire.....18c. *G. coccinea* var. *parvifolia*

Stem and leaves glabrous.....18d. *G. coccinea* var. *glabra*

Capsule ca. 10 mm. long, 1.5–2 mm. wide; anthers 4–5 mm. long. Rare, Ariz. to Coahuila..... .....18e. *G. coccinea* var. *arizonica*

18a. **Gaura coccinea** Nutt. var. **typica** n.nom.

G. coccinea Nutt. ex Pursh, Fl. Sept. Am. **2:** 733, 1816. *G. multicaulis* Raf., Atlantl. Journ., 146. 1832 new name for coccinea. *G. marginata* Lehm., in Hook., Fl. Bor. Am. **1:** 208. 1834. *G. coccinea* var. *integerrima* Torr., Ann. Lyc. N. Y., **2:** 200. 1828. *G. Roemeriana* Scheele, Linnaea **21:** 579. 1848.

Stems canescent-strigose, mostly 1–3 dm. high, more or less hirsute; leaves canescent, oblong to lanceolate, 4–8 mm. wide (the upper narrower), repand-dentate to entire, 1–3.5 cm. long; spikes mostly dense not more than 1 dm. long, usually not peduncled.

Type locality, "from the Missourie." Ranging widely from Alberta and Manitoba to eastern Calif., Ariz. and Texas. Representative material, ASSINIBOIA: Regina, *Fowler in 1903* (US). ALBERTA: Rosedale, *Moodie 1024* (G, NY, US); Medicine Hat, *Macoun 4937* (G). SASKATCHEWAN: Moose Jaw, *Johnson in 1905* (NY). MINNESOTA: Lake Traverse, Traverse Co., *Sheldon in 1893* (G, NY, US). NORTH DAKOTA: Leeds, Benton Co., *Lunelli in 1910* (NY, US); Mandan, *Sarvis 22* (US). SOUTH DAKOTA: Deadwood, *Carr 51* (G, NY, US); Jamesville, *Bruce in 1899* (US). MONTANA: Pony, Madison Co., *Rydberg & Bessey 4589* (G, NY, US); Great Falls, *Wilcox 16* (NY); Helena, *Kelsey in 1891* (P). WYOMING: Buffalo, Johnson Co., *Tweedy 3621* (NY); Dayton, Sheridan Co., *Tweedy 2604* (NY). UTAH: Towner's Ranch, *Purpus 6161* (P). NEVADA: Las Vegas, Clark Co., *Rydberg 6255* (NY); Indian Spring, *Jones in 1906* (P). CALIFORNIA: Providence Mts., e. San Bernardino Co., *Munz, Johnston & Harwood 4058* (P, US); Barnwell, *Munz 13837* (P). ARIZONA: Williams, *Toumey 160* (US); Flagstaff, *MacDougal 205* (G, NY, US); Peach Springs, *Wilson in 1893* (NY, US); Ft. Huachuca, *Wilcox in 1891* (US). COLORADO: Ft. Collins, *Crandall in 1896* (NY); Galeton, Weld Co., *Johnston 1017* (P); Sterling, Logan Co., *Mathias 335* (P); Denver, *Clokey 2779* (NY); Pueblo, *Baker, Earle & Tracy 9* (NY, P, US); Buena Vista, Chaffee Co., *Keck 848* (P); Silverton, *Tweedy 110* (US). KANSAS: Logan Co., *Hitchcock 171* (G. NY, US); Johnson, Stanton Co., *Thompson 70* (G, NY, US); Dodge City, *Ellis in 1891* (NY, US). NEBRASKA: Thedford, Thomas Co., *Rydberg 1343* (NY, US); Broken Bow, *Webber in 1889* (NY, US); Ogalalla, *Jones in 1925* (P). MISSOURI: Watson, Atchison Co., *Bush 333* (G, NY, US); Atherton, Jackson Co.,

Bush 7977 (NY). OKLAHOMA: Cherokee, Alfalfa Co., *Stevens 647* (G, NY, US); Huntsville, Kingfisher Co., *Blankinship in 1896* (G, US). NEW MEXICO: sources of the Canadian, *James*, type of var. integerrima (NY); Las Vegas, *Arsène 18788* (P); Sandia Mts., Sandoval Co., *Ellis 117* (NY, US); Datil, Catron Co., *Eggleston 20345* (NY, US); Silver City, Grant Co., *Eastwood* 8442 (G). TEXAS: Limpia Canyon, Davis Mts., *Tracy & Earle 295* (G, NY, US); Cienega Mt., Brewster Co., *Cory 2147* (P); Del Rio, ValVerde Co., *Palmer 11351* (G, NY, US); Neubraunfels, *Roemer*, Prager Herb. (Calif. Acad.) type coll. *Roemeriana*. It has been naturalized in various places outside its native range: Bingen, Wash., *Suksdorf in 1903* (NY); Brea, Orange Co., Calif., *Wolf 3809* (NY); Idaville, White Co., Ind., *Deam 48855* (G); Rochester, Mich., *Farwell 7017* (G); Rochester, N.Y. *Baxter 1007* (G); Porto Alegro, Rio Grande do Sul, Brazil, *Reinick in 1899* (G).

18b. **Gaura coccinea** Nutt. var. **epilobioides** (HBK) n.comb.

G. epilobioides HBK., Nov. Gen. et Sp. **6:** 93. 1823. *Schizocarya Kunthii* Spach, Nouv. Ann. Mus. Paris **4:** 383. 1835 new name for epilobioides. *G. sinuata* Moc. & Sessé ex Ser., in DC., Prodr. **3:** 45. 1828, as syn. *G. spicata* Moc. & Sessé ex Ser., l.c. in syn.; Moc. & Sessé, Pl. N. Hispan. ed. 1, 55. 1887–90. *G. suffrutescens* Moc. & Sessé, ex Ser., l.c. *G. bracteata* Moc. & Sessé ex Ser., l.c. *Schizocarya crispa* Spach, l.c., 384. *Gaura crispa* D. Dietr., Syn. Pl., 1298, 1840.

Stems mostly 3–4 dm. long, mostly cinereous-stringose; leaves not crowded, mostly acute to acuminate, cincereous, 1–3 cm. long, 1.5–4 mm. wide, wavy; spikes 1–2.5 dm. long, lax, often on peduncles up to 4 cm. long.

Type locality, Actopán, Hidalgo, Mexico. Ranging from Arizona and Texas to south central Mexico. Representative material, ARIZONA: Kingman, Mohave Co., *Kearney & Peebles 12591* (Sacaton); Congress Jct., Yavapai Co., *Jones in 1903* (P, US); 12 mi. no. of White River, Navajo Co., *Goodman & Hitchcock 1303* (NY, P); Santa Rita Mts., *Pringle 16* (G); Ft. Huachuca, *Palmer 417* (G, US). NEW MEXICO: Carlsbad Cavern, *Standley 40429* (US). TEXAS: Chisos Mts., *Mueller 8105* (G, NY); Chenati Mts., Presidio Co., *Nealley 156* (NY, US); Alpine, *Hughes 31* (NY); San Antonio, *Jermy* (G, NY, US). CHIHUAHUA: Chihuahua, *Palmer 369* (G, NY, US). COAHUILA: Saltillo, *Palmer 24*, (G, NY, US); DURANGO: Tepehuanes, *Palmer 275* (G, NY, US). VERA CRUZ: Orizaba, *Botteri 915* (G). NUEVO LEON: Bawes, *C. H. & M. T. Mueller 218* (P). ZACATECAS: Concepción del Oro, *Palmer 308* (G, US). SAN LUIS POTOSI: San Luis Potosi, *Parry & Palmer 255* (G, US). HIDALGO: Actopán, Humboldt, type coll (Ber, photo at P; apparently

same at Paris); Pachuca, *Rose Painter & Rose, 8820* (NY, US). MEXICO: Jacaboys, *Pringle 10397* (G, US); San Angel, drawing of G. sinuata fl. mex., G. bracteata Ser. (Del, G, P); PUEBLA: Tehuacán, *Seler 8* (G). Without locality, G.? suffrutescens Sessé & Mociño, pl. Geneva (Del, tracing G, P); G. sinuata, *Sessé, Mociño, Castillo & Maldonado 5148 & 938* (Madria).

More southern, taller, more lax, with leaves less crowded and more wavy than in var. *typica*, but intergrading freely with it; for example, Flagstaff, Ariz., *Munz 13001* (P); Oracle, Ariz., *Jones in 1903* (P); Sonoita, *Loomis & Peebles 5351A* (Sacaton, US); Bill Bunton's Ranch, Presidio Co., Texas, *Cory 2141* (P); Kiowa Creek, Sterling Co., Texas, *Cory 584* (P); Parras, Coahuila, *Gregg in 1847* (G, NY).

18c. GAURA COCCINEA Nutt. var. PARVIFOLIA (Torr.) T. & G., Fl. N. Am. **1**: 518. 1840.

G. parvifolia Torr., Ann. Lyc. N.Y. **2**: 201. 1828. *G. linearis* Woot. & Standl. Contr. U. S. Nat. Herb. **16**: 154. 1913.

Branches and leaves subglabrous to pubescent; leaves quite linear, entire mostly 5–15 mm. long, 1–2 mm. wide.

Type locality, "On the Canadian." Ranging from Kansas and Colorado to northern Mexico. Representative material, KANSAS: Kandrado, *Smyth 459* (NY); Goodland, *Smyth in 1892* (NY); Tribune, Greeley Co., *Reed in 1892* (P). COLORADO: Pueblo, *Popenoe in 1878* (P); NEW MEXICO: On the Canadian *James*, type (NY); Tularosa Creek, Otero Co., *Wooton in 1897* (G, US); Albuquerque, *Jones 4120* (P); Lakewood, *Wooton in 1909*, type linearis (US); Silver City, Grant Co., *Wolf 2625* (G, P). ARIZONA: Cottonwood, *Rothrock 349* (G, US); Elgin, So. Ariz., *Peebles, Harrison & Kearney 3363* (Sacaton); Ft. Huachuca, *Wilcox in 1894* (US). TEXAS: Culberson Co., *Cory 2142* (P); Red River above Burkburnett, *Tharp 524* (NY); Vernon, *Reverchron 3846* (G, US). CHIHUAHUA: San Pedro, Sierra Madre, *Jones in 1903* (P); Casas Grandes, *Nelson 6336* (US). ZACATECAS: Concepción del Oro, *E. Palmer 318* (NY).

Intergrading freely with var. *typica*, as for example, Trail Glen, Colo., *Clements 45* (G, NY); Durango, Colo., *Tweedy 440* (NY, US); Alpine, Texas, *Cory 9281* (P), *Palmer 34029a* (NY); Las Vegas, New Mex., *Arsène 18363* (P); Ft. Bayard, New Mex., *Mulford 570* (NY); so. of Raton, N. M., *Mathias 539* (P). Smoother plants intergrade with var. *glabra:* Santa Fé, New Mex., *Bertrand 66* (US); Dulca, Jicarilla Apache Reservation, *Standley 8165* (US); San Ysidro, *Arsène 19012* (US); Ute Park, Colfax Co., New Mex., *Standley 13866* (US); Seward Co., Kansas, *Carleton 334*

(US); Huachuca Mts., Ariz., *Holzner 1568* (US); San Francisco Mts., *Knowlton 175* (US).

18d. GAURA COCCINEA Nutt. var. GLABRA (Lehm.) Torr. & Gray, Fl. N. Am. 1: 518. 1840.

G. glabra Lehm. in Hook., Fl. Bor. Am. 1: 209. 1834. *G. induta* Woot. & Standl., Contrib. U. S. Nat. Herb. **16**: 153. 1913.

Plant nearly or quite glabrous on stems and leaves; leaves as in var. *typica*, but more wavy; hypanthium strigulose.

Type locality, "About Carlton-House, on the Saskatchawan." With much the same range as var. *typica* and in some regions (Wyo. & Colo.) seemingly more abundant than that variety; perhaps this should be rated as only a form, since its glabrous condition is its chief character, but its tendency toward more wavy leaves may argue for varietal recognition. Material from northeastern New Mexico and eastern Colorado tends to have narrow leaves and is Wooton and Standley's *induta;* it is somewhat intermediate with var. *parvifolia*. Plants from Wyoming and Montana have very blunt and short lower leaves; but intermediate material between these extremes and the usual form is more abundant than any of the extremes themselves. Representative material may be cited as follows, NEBRASKA: Kimball, *Moldenke 7232* (NY). KANSAS: Tribune, Greeley Co., *Reed in 1892* (P); Liberal, Seward Co., *Rydberg & Imler 868* (NY). MONTANA: Ravalli, *Jones in 1909* (P); Custer, Yellowstone Co., *Lloyd in 1893* (NY); Pony, Madison Co., *Rydberg & Bessey 4590* (NY). SOUTH DAKOTA: Ft. Pierce, *Harper in 1891* (P); Hot Springs, Fall River Co., *Rydberg 709* (NY, US). WYOMING: Buffalo, Sheridan Co., *Tweedy 3620* (NY); Platte Hills, *Nelson 392* (G); Sybille, Albany Co., *Nelson 7412* (G, NY, P, US); Granger, Sweetwater Co., *Jones in 1896* (P), *Merrill & Wilcox 787* (NY, US). COLORADO: Livermore, Larimer Co., *Munz 11124* (P); New Windsor, Weld Co., *Osterhout in 1901* (NY, P); Denver, *Jones 657* (P, US); Gunnison, *Baker 456* (G, NY, P, US); Trinidad, *Mulford 10* (NY). UTAH: St. George, Washington Co., *Jones 5110* (P, US); San Juan River, *Eastwood 30* (G, US). NEVADA: Las Vegas, *Craig 1392* (P), *Goodding 2303* (G, NY). CALIFORNIA: Clark Mt., eastern Mohave Desert, *Munz 12857* (P). ARIZONA: Prescott, *Wolf 2348* (G); Hackberry, Mohave Co., *Jones 4475* (G, NY, P in part, US); Rye, Gila Co., *Jones in 1890* (P); Ft. Huachuca, *Palmer 420* (US). NEW MEXICO: Santa Fe, *A. A. & E. G. Heller 3659* (G, NY, P); White Mts., Lincoln Co., *Wooton 186* (G, P); Pecos, San Miguel Co., *Standley 4933*, type coll. induta (G, NY, US); Farmington, San Juan Co., *Standley 6919* (US). OKLAHOMA:

Alva, Woods Co., *Stevens 658* (NY, US). TEXAS: El Solitario, Brewster Co., *Cory 2140* (P); near Kirkland, Hardeman Co., *Cory 13366* (P).

18e. **Gaura coccinea** Nutt. var. **arizonica** n. var.

Stems several, 3–6 dm. high, branched, canescent-strigulose, densely leafy; main leaves lanceolate to lance-ovate, wavy, 2–5 cm. long, 3–8 mm. wide; floral bracts lance-linear, 4–12 mm. long; spikes 3 dm. long in fruit; hypanthium cinereous-strigulose, narrow, 6–7 (10) mm. long; sepals cinereous-strigulose, 9–10 mm. long; petals 6 mm. long; anthers 4–5 mm. long; capsule usually cinereous-strigulose, ca. 1 cm. long, 1.5–2 mm. wide, thickest at about the middle, with a rather long-acuminate beak. (Caules 3–6 dm. alti, canescento-strigulosi; foliis lanceolatis aut lanceo-ovatis, undulatis, 2–5 cm. longis; hipantio cinereo-striguloso, angusto, 6–7 (10) mm. longo; sepalis cinereo-strigulosis, 9–10 mm. longis; petalis 6 mm. longis; antheris 4–5 mm. longis; capsulis 1 cm. longis, 1.5–2 mm. latis, rostratis, cinereo-strigulosis).

Type, Globe, Arizona, *Eastwood 8657*, May 17, 1919, Gray Herbarium. Other material seen, ARIZONA: Globe, *Kearney & Peebles 9263* (Sacaton, US), *9262* (Sacaton, US); Marana, Pima Co., *Harrison & Fulton 6817* (Sacaton); between Casa Grande & Tucson, *Harrison 6817* (US); Marana, *Loomis & Peebles* (Sacaton); Prescott, *Peebles, Harrison & Kearney 4288* (Sacaton); Mesa near Rock & Rye Creeks, Gila Co., *Collom 86a* (US). NEW MEXICO: Gallinas River, *Eggleston 5973* (US). COAHUILA: Carneros Pass, *Pringlw 3105* (NY, US in part).

Characterized by its long anthers and long narrow capsules, this variety might almost seem to be worthy of specific recognition and it was in that fashion that I first treated it. But it does intergrade with *G. coccinea* var. *glabra*, for example, *Kearney & Peebles 9263* above cited, also *Toumey 144* from Hot Springs, Ariz (US).

UNCERTAIN OR EXCLUDED NAMES

GAURA CHINENSIS Lour., Fl. Cochin., 225 1790. The sessile stigma, erect petals and other characters mentioned in Loureiro's description would exclude this yellow-flowered plant from *Gaura*. At the present writing I do not have access to literature on Chinese Botany and do not know what disposition has been made of this name.

GAURA EPILOBIA Moc. & Sesse, ex Ser., in DC., Prodr. 3: 45. 1828 is *Oenothera* (Hartmannia) *rosea* Ait., Hort. Kew. ed. 1, **2:** 3. 1789.

GAURA? FRUTICULOSA Benth., Voy. Sulph., 15. 1844 is *Gonglyocarpus fruticulosus* Brandg., Proc. Calif. Acad. II, **2:** 158. 1889.

GAURA FRUTICOSA Loefl., Iter Hispan., 248. 1758 is *Combretum fruticosum* Stuntz, U. S. Dept. Agric., Bur. Pl. Ind., Invent. Seeds & Pl. Import. No. **31:** 86. 1914.

Explanation of figures

(This plate is made to illustrate the shapes of the fruits of the various species of *Gaura*. In order to avoid confusion, no shading nor pubescence is indicated). All specimens indicated are in Pomona College Herbarium.)

Fig. 1. *Gaura mutabilis* Cav. Fruit 9 mm. long; Colonia Juarez, Mex., *Jones in 1903.*

Fig. 2. *Guara parviflora* Dougl. var. *typica*. Fruit 8 mm. long; Shawmut, Mont., *C. L. Hitchcock 2441.*

Fig. 3. *Gaura biennis* L. var. *typica*. Fruit 6.5 mm. long; Philadelphia, Penn., *G. Watson.*

Fig. 4. *Gaura neomexicana* Woot. var. *typica*. Fruit 8 mm. long; Tularosa Creek, Otero Co., New Mex., *Wolf 2768.*

Fig. 5. *Guara macrocarpa* Rothrock. Fruit 14 mm. long; Jeff Davis Co., Tex., *Cory 2137.*

Fig. 6. *Gaura Lindheimeri* Engelm. & Gray, Fruit 9 mm. long; Houston, Tex., *Munz 13339.*

Fig. 7. *Gaura angustifolia* Michx. var. *typica*. Fruit 8 mm. long; Ortega, Fla. *O'Neill 1011.*

Fig. 8. *Gaura filformis* Small var. *typica*. Fruit 6 mm. long; Dickenson, Galveston Co., Tex., *Cory 11398.*

Fig. 9. *Gaura suffulta* Engelm. var. *typica*. Fruit 6 mm. long; Live Oak Creek, Crockett Co., Tex., *Cory in 1936.*

Fig. 10. *Gaura gracilis* Woot. & Standl. var. *typica*. Fruit 7 mm. long; Black Range, New Mex., *Metcalfe 1033.*

Fig. 11. *Gaura brachycarpa* Small. Fruit 9 mm. long; Sabinal, Tex., *Jones 29570.*

Fig. 12. *Gaura tripetala* Cav. var. *typica*. Fruit 8 mm. long; Hempstead, Tex., *E. Hall 211.*

Fig. 13. *Gaura villosa* Torr. var. *typica*. Fruit 13 mm. long; near Romero, Hartley Co., Tex., *Cory 16424.*

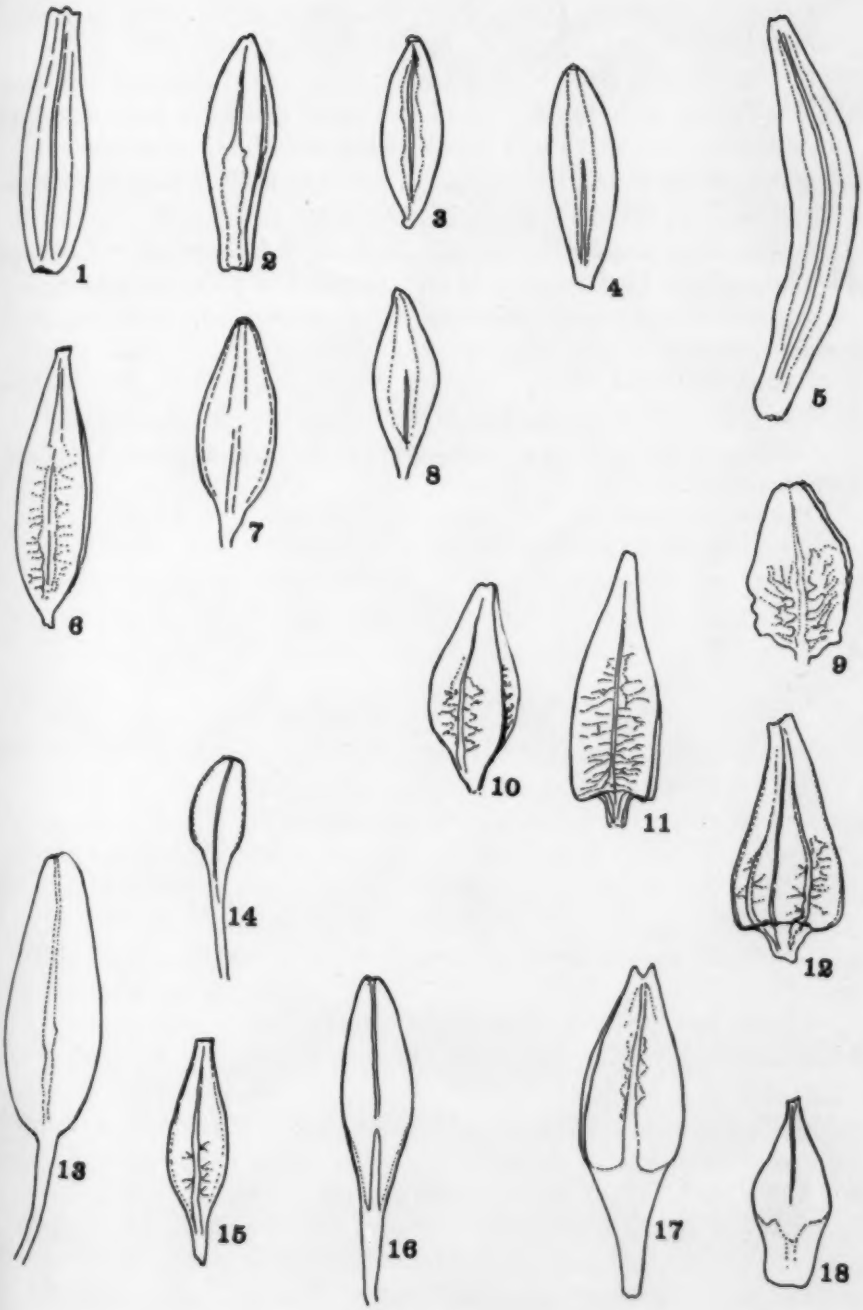
Fig. 14. *Gaura filipes* Spach. var. *typica*. Fruit 8 mm. long; Auburn, Ala., *Earle & Baker in 1897.*

Fig. 15. *Gaura Nealleyi* Coulter. Fruit 8 mm. long; Limpio Canyon, Tex., *Cory 9659.*

Fig. 16. *Gaura sinuata* Nutt. Fruit 10 mm. long; Diversion Lake, Archer Co., Tex., *Cory 13222.*

Fig. 17. *Gaura odorata* Sesse. Fruit 10 mm. long; Austin, Texas, *E. Hall 213.*

Fig. 18. *Gaura coccinea* Nutt. var. *typica*. Fruit 7 mm. long; Big Lake, Reagan Co., Tex., *Cory 585.*



Figures 1-18. Explanation on opposite page

GUARA HETERANDRA Torr., Pacif. RR. Rept. **4:** 87. 1857 is *Heterogaura heterandra* Cov., Contr. U. S. Nat- Herb. **4:** 106. 1893.

GAURA HIRSUTA Scheele, Linnaea **21:** 580, 1848. I am uncertain from the description as to application of this name and have been unable to locate the type on which it is based. It may well be *G. Lindheimeri.*

GAURA HUMILIS D. Dietr. Syn. Pl. 2: 1297. 1840 is *Gayophytum humile* Juss., Ann. Sci. Nat. ser. 1, **25:** 18. 1832.

GAURA LAXA Loefl., Iter Hispan., 248. 1758 is *Combretum Loeflingii* Eichl., in Mart., Fl. Bras. xiv, **2:** 110 according to Index Kewensis.

GUARA LEUCOCARPA Comien, ex Steud., Nom., ed. 2, **1:** 666. 1840, nomen nudum.

GAURA LINIFOLIA Nutt., ex James, Exped. Rocky Mts., **2:** 355, 1823 is *Stenosiphon linifolium* Britton, Mem. Torrey Club **5:** 236. 1894.

GAURA UNDULATA Desf., Tableau de l'Ecole de Bot., ed. 2, 196. 1815, nomen nudum.

POMONA COLLEGE,
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Effect of artifical wind on growth and transpiration in the Italian millet, Setaria italica

V. Panduranga Rao

(with one figure)

Wind is one of the potent environmental factors that affect vegetation. Notwithstanding its importance, the literature upon this subject is meager and is largely confined to non-agricultural plants, sugar cane and orchard trees being the chief exceptions. The problem is especially important in those parts of India where moderate to strong winds prevail during the growing period and occasionally contribute to widespread destruction of crops.

The great importance of *Setaria italica* as a food crop for the poorer classes in these semiarid regions makes its behavior toward wind especially interesting.

MATERIAL AND METHODS

Strain No. K. 23 of *Setaria italica* Beauv., developed at the Dry Farming Station, Bellary, South India, was used in this experiment, which was carried out in the greenhouse at Lincoln, Nebraska, during the summer of 1937.

Moist, screened, fertile and well mixed loess soil was uniformly tamped into eight cylindrical, galvanized iron containers that were 9 inches in diameter, 19 inches deep, and contained one-half inch of gravel. The top of each completely filled container was tightly covered with water-proof oilcloth. A tightly fitting 3-inch cork containing 3 half-inch holes was placed in an opening cut in the center of each cover and sealed with liquid glue to prevent loss of moisture. On June 22, two seeds were planted in the soil just below each of the holes in the corks, the holes filled with sand, and the phytometers weighed.

Five days after germination the seedlings were thinned to three per container, *i.e.*, one per opening. The eight phytometers were arranged in two sets of four each and each set was insulated by wrapping it with several thicknesses of heavy brown paper. One lot of six-day-old seedlings was placed 2 feet from a 16-inch electric fan where a wind velocity of 5 m.p.h. was created when the fan was run from 9 to 11 a.m. and from 3 to 5 p.m. the first day. On the next day, the fan was run from 6 a.m. to 6 p.m., and on the third day at 10 a.m. the wind velocity was increased to 11 m.p.h. until 6 p.m. This latter velocity was then maintained from 6 a.m. to 6 p.m. daily throughout the experiment. The phytometers were restored to their original weight at intervals by addition of water. Detailed notes of the

condition of the plants and of water used were taken. The second lot, in the meantime, was placed under conditions that were similar except for the absence of wind. Loss of water was determined by frequent weighing, enough water being added to replace that transpired.

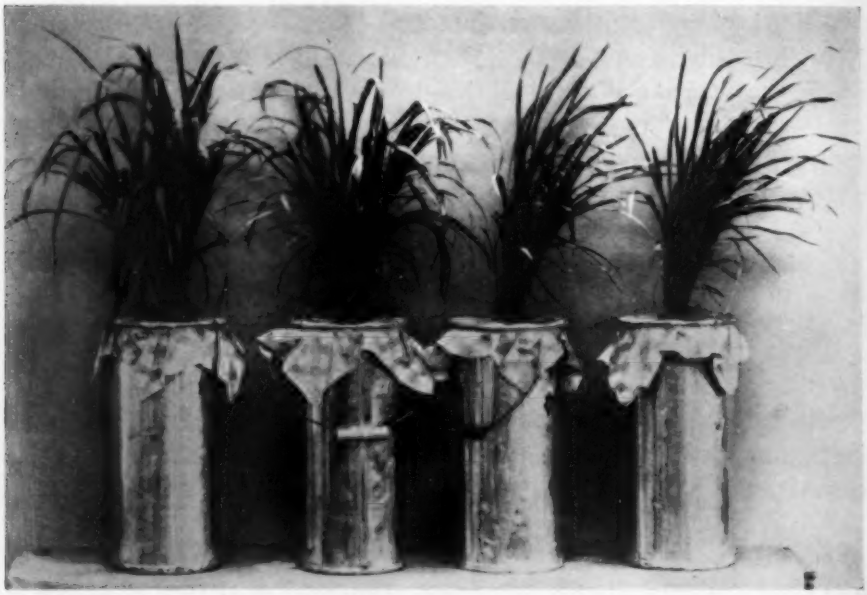

Fig. 1. Two lots of control plants of *Setaria italica* (left) and two groups that have been exposed to wind 12 hours daily.

Average daily evaporation from Livingston's black spherical atmometers was 46.7 cc. near plants exposed to the wind, and 20.7 cc. near the controls. The summer was very warm and temperatures of 100° to 110°F. were frequently attained during the early afternoon, despite the fact that the greenhouse was unusually well ventilated and the glass partly covered with whitewash. The air temperature (of numerous readings made between 10 a.m. and 2 p.m.—97.1°F.) was 3.3°F. lower about the plants in the wind. The light intensity on the treated plants was 6700 foot candles, which was almost identical with that of the controls. The average relative humidity during the experiment, as determined by numerous readings of a cog psychrometer, was 69 per cent.

At the end of a month of treatment, after weighing the phytometers, the shoots were oven-dried at 90°C. for 24 hours and weighed. The containers were placed in a slanting trough, their sides cut open, and the roots, which had nearly reached the bottoms of the containers, were exposed by carefully washing away all the soil with a gentle stream of water. Root

volumes, obtained by displacement of water, and oven-dry weights were secured.

RESULTS

The effect of the wind became visible on the fifth day when tips and margins of the first three leaves began to dry. Notwithstanding this symptom, the plants continued to grow more vigorously than the controls for the first 13 days of treatment as shown in table 1.

TABLE 1

Effect of wind upon the height of Setaria italica.

AGE OF SEEDLING, DAYS	DAYS AFTER TREATMENT	HEIGHT IN CM. CONTROL (WITHOUT WIND)	HEIGHT IN CM. EXPERIMENTAL (WITH WIND)
10	4	5.1	6.7
12	6	8.5	12.1
14	8	16.2	21.2
16	10	21.4	24.9
19	13	31.2	32.9
23	17	43.9	38.7
27	21	52.9	47.3
37	31	67.2	59.7

The accelerated growth of the treated plants may have been related to the lower temperature of the surrounding air. After the 13th day, however, the plants in the wind lagged behind the controls. They had shorter, thinner stems and slightly narrower, shorter leaves with dry tips (fig. 1). Adverse effects of the wind treatment used were further shown by the production of fewer tillers and by less dry matter in both tops and roots. There was also a considerable decrease in the volume of the roots. Moreover, water requirement was nearly double that of the controls (table 2).

TABLE 2

Effects of wind upon the development of Setaria italica
(average of 12 plants in each lot)

CRITERIA	CONTROL (WITHOUT WIND)	EXPERIMENTAL (WITH WIND)	RATIO OF CONTROL TO EXPERIMENTAL PLANTS
Height, cm.	67.2	59.7	1:0.89
Number of tillers	5.2	4.0	1:0.77
Thickness of stalk, cm.	0.8	0.6	1:0.75
Width of widest leaf, cm.	1.44	1.27	1:0.88
Weight of shoot, gm.	4.1	2.93	1:0.71
Weight of roots, gm.	1.51	0.89	1:0.59
Volume of roots, cc.	13.75	8.5	1:0.62
Water requirement, lbs.	511.7	968.5	1:1.89
Water transpired, lbs.	6.33	8.16	1:1.29

DISCUSSION

The depressing influence of strong wind upon the growth of vegetation is well known but quantitative data are meager. Blanchard (1934) compared the growth and yield of two orchards of Eureka lemons and found that the factor of improvement in yield due to protection from wind was 5 to 7 and in size of trees about 3. A reduction of about 50 per cent in dry weight of marigolds grown under a constant wind velocity of 15 m.p.h. was reported by Finnell (1928). Martin and Clements (1935) made a thorough study of the effect of constant wind velocities of 5, 10, and 15 m.p.h. on shoots of *Helianthus annuus*. Using different wind velocities and plants in various stages of development, they found in all experiments that leaf area, stem height and diameter, dry weight, and total transpiration, as well as number of xylem elements and xylem area, decreased with increasing wind velocity. The water requirement at the highest wind velocity, 15 m.p.h., was increased 50 per cent. These authors also give a summary of the conflicting literature on this subject, none of which makes reference to the effect upon root systems.

SUMMARY

Plants of Italian millet (*Setaria italica* Beauv.) were grown in continuous wind 12 hours daily for 31 days. The tips and margins of the first three leaves began to dry after the fifth day. The treated plants grew more rapidly than the controls the first 13 days, but less rapidly thereafter. Tops of plants subjected to wind were shorter, lighter in weight, thinner stalked, and had narrower leaves and fewer tillers. These plants also had lighter and less bulky root systems. The water requirement was approximately doubled.

The author wishes to express his sincere appreciation to Dr. J. E. Weaver, under whose direction this work was done.

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LINCOLN, NEBRASKA

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Blanchard, V. F. 1934. Depressing effect of wind on growth and yield of citrus trees. California Citrogr. **19**: 206–207.

Finnell, H. H. 1928. Effect of wind on plant growth. Jour. Amer. Soc. Agron. **20**: 1206–1210.

Martin, E. V., and Clements, F. E. 1935. Studies of the effect of artificial wind on growth and transpiration in *Helianthus annuus*. Plant Physiol. **10**: 613–636.

Studies in Penstemon VI. The section Aurator

David D. Keck

Aurator, proposed as a new section in the scrophulariaceous genus *Penstemon*, contains eighteen species as here defined. These all occur in western North America under semi-arid conditions at moderate elevations. The plants are relatively low, herbaceous perennials, marked by their prominently glandular-viscid inflorescence, explanate anthers and usually by their prominently bearded staminode.

The following herbaria have been consulted in the course of this study:

C—University of California, Berkeley.
CAS—California Academy of Sciences, San Francisco.
CI—Carnegie Institution at Washington, Stanford University, Calif.
CM—Carnegie Museum, Pittsburgh, Pa.
F—Field Museum, Chicago.
GH—Gray Herbarium, Harvard University, Cambridge.
M—Missouri Botanical Garden, St. Louis.
Minn—University of Minnesota, Minneapolis.
NY—New York Botanical Garden.
Ph—Academy of Natural Sciences, Philadelphia.
Po—Pomona College, Claremont, Calif.
Pul—State College of Washington, Pullman.
RM—Rocky Mountain Herbarium, University of Wyoming, Laramie.
SU—Dudley Herbarium, Stanford University, Calif.
US—United States National Herbarium, Washington, D. C.

I am grateful to those in charge of these collections for permission to study materials. I am particularly indebted to Dr. F. W. Pennell, of the Academy of Natural Sciences of Philadelphia, whose authoritative suggestions on problems in *Penstemon* I have sought many times, both in regard to the present section of the genus and many others as well.

BOUNDARIES OF THE SECTION

F. W. Pennell, in his recent monograph on the Scrophulariaceae of Eastern Temperate North America (Acad. Nat. Sci. Phila. Monogr. 1, 1–650, 1935) provisionally treated *Penstemon Cobaea* Nutt., *P. triflorus* Heller, *P. guadalupensis* Heller and *P. albidus* Nutt., as members of a distinct section, *Albidi*. To this proposal I do not agree, because the study of the four, together with the other species included in the present paper, leads me to the conclusion that all must be considered as members of a single section. Thus circumscribed, the group is natural from the standpoints of comparative morphology and distribution, and homogeneous throughout due to a

close interconnection of the components. For example, Pennell would separate the sections *Albidi* and *Cristati* on the presence of glands within the corolla-throat in the former and their absence in that position in the latter, but this criterion falters in the cases of *P. Jamesii* and *P. eriantherus*, which Pennell would assign to the *Cristati*, and in *P. guadalupensis* of his *Albidi*. *Penstemon Jamesii* is definitely glandular within the corolla in its two larger subspecies, as much so as the average species of *Albidi*. Occasionally *P. eriantherus* is moderately glandular within, especially on the lateral lobes of the lower lip. *P. guadalupensis*, on the other hand, is sometimes essentially glandless within the corolla. The four species assigned by Pennell to the *Albidi* are not villous-bearded on the lower lip of the flower, whereas the majority of the other species considered in this paper are. The lack of bearding, however, occurs in some of the latter that are otherwise notably different and widely separated geographically, so the character is one whose presence or absence runs counter to the most probable phylogenetic sequence and consequently its importance should not be magnified.

There is no geographic hiatus between the members of the *Albidi* and the *Cristati*. The various species form a network over the country, occupying adjacent areas after the manner of ecospecies that have evolved from ecotypes, and although the members of the *Albidi* are the easternmost, I find no excuse for grouping them apart, even as a subsection.

Since Pennell's treatment of these four species is adequate and generally available, I have avoided a complete repetition here, contenting myself with summarizing his distributional data and keying out his units. The latter I subscribe to fully, with the exception regarding sections, including his statement that the treatments of *P. triflorus* and *P. guadalupensis* are provisional, because my independent examination of material leads me to similar results and does not warrant additional revision. It appears to be a natural presumption that *P. guadalupensis* represents a southern derivative of *P. albidus* (or vice versa), whereas *P. Cobaea* and *P. triflorus* are most closely related to each other. Furthermore, it is to all appearances a narrow step from *P. guadalupensis*, and perhaps from *P. albidus*, to *P. Jamesii*, *P. auriberbis* and relatives.

Section **Aurator**, sect. nov.

Low, mostly short-lived herbaceous perennials; stems few to several crowning the taproot or praemorse rootstock, erect; leaves mostly entire but in all species at least potentially toothed, dimorphic, those of the basal rosette petiolate, the lower cauline often petiolate gradually becoming sessile upwards, the upper cauline usually widest at base and often clasping; inflorescence

± prominently glandular-pubescent; calyx-lobes lanceolate; corolla glandular-pubescent without, the throat rounded, scarcely if at all plicate, usually pilose at orifice across base of lower lip; fertile stamens glabrous, their authers sometimes minutely ciliolate-denticulate, sterile stamen usually densely bearded with prominent flattened hairs, rarely glabrate. Type species, *P. eriantherus* Pursh. Included here are the *Albidi* and *Cristati*, variously called species-groups or sections by authors, but in compliance with Article 26 of the International Rules I am proposing a sectional name in substantive form. The Latin noun *aurator*, the gilder, is employed in reference to the prominent yellow beard found on the staminode of most species that simulates a brush dipped in gilt.

KEY TO THE SPECIES OF SECTION AURATOR

A. Throat glandular within but not villous; staminode lightly bearded; anther-sacs peltately explanate.
B. Corolla 25–50 mm. long, 9–25 mm. wide at throat.
C. Corolla over 35 mm. long, the throat abruptly much inflated; capsule 12–14 mm. long ..... 1. *P. Cobaea*
D. Corolla pale violet-purple or white; foliage pale green ..... 1a. *P. C.* subsp. *typicus*
DD. Corolla deep purple; foliage deeper green ..... 1b. *P. C.* subsp. *purpureus*
CC. Corolla less than 35 mm. long, the throat gradually and moderately inflated; capsule 11–12 mm. long ..... 2. *P. triflorus*
E. Cauline leaves lanceolate to ovate-oblong, usually sharply serrate; corolla mostly 30–35 mm. long, "white, pink, or pink-red" ..... 2a. *P. t.* subsp. *typicus*
EE. Cauline leaves widely linear to lanceolate, essentially entire; corolla mostly 25–30 mm. long, "lavender" ..... 2b. *P. t.* subsp. *integrifolius*
BB. Corolla 12–20 mm. long, 5–8 mm. wide at throat, white or tinged with purplish.
F. Leaves glabrate; corolla sparingly glandular-puberulent without and within ..... 3. *P. guadalupensis*
G. Corolla 15–20 mm. long; cauline leaves linear ..... 3a. *P. g.* subsp. *typicus*
GG. Corolla 12–15 mm. long; cauline leaves elliptic-lanceolate ..... 3b. *P. g.* subsp. *Ernesti*
FF. Leaves scabrid-puberulent; corolla densely glandular-pubescent without and within ..... 4. *P. albidus*
AA. Throat not glandular within, or if glandular, villous at orifice.
H. Anther-sacs dehiscent quite to proximal apices. Southern Colorado.
I. Corolla 18–22 mm. long, 7–8 mm. wide at throat ..... 5. *P. auriberbis*
II. Corolla 12 mm. long, 5 mm. wide at throat ..... 6. *P. parviflorus*
HH. Anther-sacs dehiscent throughout and through the partition (except in 11).
J. Throat viscid-glandular within (except in 7c); anther-sacs peltately explanate ..... 7. *P. Jamesii*
JJ. Throat not glandular within (sometimes sparingly glandular in 16).
K. Staminode included; ovary glabrous.
L. Corolla blue-purple; anther-sacs not explanate.
M. Inflorescence, including calyces, glandular-pubescent, not additionally puberulent. Utah-Colorado ..... 8. *P. Moffatii*
MM. Inflorescence, including calyces, scarcely viscid but densely puberulent.
N. Leaves lanceolate to elliptic, 4–8 mm. wide; staminode bearded on outer half. Utah ..... 9. *P. dolius*
NN. Leaves linear to linear-oblanceolate, 2–4 mm. wide; staminode bearded throughout. Idaho ..... 10. *P. pumilus*

LL. Corolla pinkish or reddish. California.
O. Anther-sacs not explanate, 1.3 mm. long; corrolla 14–20 mm. long, somewhat ventricose. East of Owens Valley....11. *P. monoensis*
OO. Anther-sacs explanate, 0.5 mm. long; corolla 11–14 mm. long, narrowly tubular. ....12. *P. calcareus*
KK. Staminode exserted.
Q. Capsule (and ovary) glabrous.
R. Anther-sacs peltately explanate, the line of contact long; staminode densely bearded throughout with short orange-yellow hairs.
S. Corolla 13–28 mm. long. Nevada westward....13. *P. miser*
SS. Corolla 30–35 mm. long. Utah....14. *P. Grahamii*
RR. Anther-sacs not fully explanate, the line of contact relatively short; staminode sparingly bearded with yellow hairs....15. *P. Gormanii*
QQ. Capsule (and ovary) glandular-puberulent.
T. Anther-sacs peltately explanate, as broad as long, the line of contact long.
U. Corolla 20–35 mm. long, 9–14 mm. wide at throat, pilose at orifice.... ....16. *P. eriantherus*
UU. Corolla 16–25 mm. long, 6–9 mm. wide at throat, more densely pilose at orifice....17. *P. Cleburnei*
TT. Anther-sacs not explanate, much longer than broad, the line of contact short ....18. *P. Whitedii*

1. PENSTEMON COBAEA Nutt.

Penstemon Cobaea Nutt., Trans. Amer. Phil. Soc. **2**: 5: 182, 1837.

1a. PENSTEMON COBAEA subsp. TYPICUS Pennell

Penstemon Cobaea subsp. *typicus* Pennell, Acad. Nat. Sci. Phila. Monogr. 1: 249. 1935.

P. Hansonii A. Nels., Univ. Wyom. Publ. Bot. **1**: 129. 1926.

Open prairies from southeastern Nebraska, southward through Kansas and Oklahoma to the Coastal Plain of southeastern Texas.

1b. PENSTEMON COBAEA subsp. PURPUREUS Pennell

Penstemon Cobaea var. *purpureus* Pennell, Proc. Acad. Nat. Sci. Phila. **73**: 490. 1921.

P. Cobaea subsp. *purpureus* Pennell, Acad. Nat. Sci. Phila. Monogr. 1: 250. 1935.

"Rocky calcareous barrens and cliffs, valley of the White River, Ozark Mountains of northern Arkansas and southern Missouri."

2. PENSTEMON TRIFLORUS Heller

Penstemon triflorus Heller, Contr. Herb. Franklin & Marshall Coll. 1: 92. pl. 8. 1895.

A variable species much in need of intensive field study and garden experiment.

2a. PENSTEMON TRIFLORUS subsp. TYPICUS Pennell

Penstemon triflorus subsp. *typicus* Pennell, Acad. Nat. Sci. Phila. Monogr. **1**: 251. 1935.

P. Helleri Small, Bull. Torr. Club 25: 471, 1898.
Central Texas from Nolan to Bexar and Uvalde counties.

2b. PENSTEMON TRIFLORUS subsp. INTEGRIFOLIUS Pennell

Penstemon triflorus subsp. *integrifolius* Pennell, l. c.
P. triflorus var. *integrifolius* Cory, Rhodora **38:** 407. 1936.

Western Texas from the Upper Concho River southerly to Kinney County; apparently overlapping the distribution of subsp. *typicus* in the southern portion of its range and there, due to the consequent hybridization, less clearly differentiated.

3. PENSTEMON GUADALUPENSIS Heller

Penstemon guadalupensis Heller, Contr. Herb. Franklin & Marshall Coll. 1: 92. pl. 7. 1895.

I have seen very scanty material of this species and so am relying wholly upon Pennell's classification.

3a. PENSTEMON GUADALUPENSIS subsp. *typicus* Pennell

Penstemon guadalupensis subsp. *typicus* Pennell, l.c. 252.

In the upper drainages of the Colorado and Guadalupe rivers of central Texas, from Nolan and Comanche counties to Kerr County.

3b. PENSTEMON GUADALUPENSIS subsp. ERNESTI Pennell

Penstemon guadalupensis subsp. *Ernesti* Pennell, l.c.
P. guadalupensis var. *Ernesti* Cory, Rhodora **38:** 407. 1936.

Valley of the upper Colorado River in western Texas.

4. PENSTEMON ALBIDUS Nutt.

Penstemon teretiflorus Nutt., Fraser's Catal. 2, n. 66, 1813, nomen nudum.
P. albidus Nutt., Gen. Pl. **2:** 53. 1818.
P. viscidulus Nees, in Neuwied, Reise Nord-Amer. **2:** 444. 1841.
Chelone albida Spreng., Syst. Veg. **2:** 813. 1825.

A widespread species of the prairies and plains east of the continental divide from southern Manitoba, Saskatchewan and Alberta, southward to western Minnesota and Oklahoma, northern Texas and easternmost New Mexico.

5. PENSTEMON AURIBERBIS Pennell

Penstemon auriberbis Pennell, Contr. U.S. Nat. Herb. **20:** 339. 1920.

Stems 10–20 cm. tall, pubescent; leaves linear to linear-lanceolate, 4–8 cm. long, 2–7 mm. wide, entire or nearly so, glabrous or usually puberulent; calyx-lobes linear-lanceolate, usually attenuate; corolla 18–22 mm. long, 7–8 mm. wide at throat, pale lilac to purplish blue with faint guide lines, not

glandular within, the throat ampliate, the limb spreading, the lower lip pilose at base; anther-sacs widely divaricate, dehiscent quite to proximal apices, not explanate; staminode ± exserted, dilated apically, densely bearded for its entire length with long yellow hairs.

Valleys of the Arkansas and Rio Grande rivers in southern Colorado. Type locality: "a dry sandy sagebrush slope, east of Fountain Creek, northeast of Pueblo, Pueblo County, Colorado, altitude about 1,400 meters."

COLORADO. KIOWA CO.: 10 mi. w. of Haswell, *Ownbey 752* (CI). EL PASO CO.: Colorado Springs (GH); 15 mi. S. of Colorado Springs, (CI); 18 mi. S. of Colorado Springs, *Keck 870* (C, CAS, CI, M, Ph, Po, SU); Fountain (M). FREMONT CO.: Canon City, *Pennell 6312* (F, GH, M, NY, RM, US), *Nelson 10543* (C, M, NY, RM). PUEBLO CO.: Pueblo, *Pennell 5731* (NY, type; isotypes GH, RM, US), *5733* (F, M, NY, Ph); Swallows, *Baker 6* (C, GH, M, NY, RM, US). OTERO CO.: Apishipa Creek, *Osterhout 2039* (RM); Rocky Ford, *Osterhout 2084* (NY). HUERFANO CO.: Walsenburg, *Bethel et al. 4284* (CAS, CI, M, Ph, RM, SU, US), *Nelson 11523* (C, M, NY, RM, SU); La Veta (Ph); Badito, *Rydberg & Vreeland 6610* (NY); La Veta Pass, *Bethel et al. 4283* (NY, Ph, RM, US). ALAMOSA CO.: Alamosa, *Porter 2029* (CI). COSTILLA CO.: Sangre de Cristo Creek, *Rydberg & Vreeland 5635* (NY). LAS ANIMAS CO.: Trinidad, *Eastwood 5587* (CAS); Barela (CAS, NY). NEW MEXICO. UNION CO.: Emery Gap to Branson, *Eggleston 20150* (NY).

6. PENSTEMON PARVIFLORUS Pennell

Penstemon parviflorus Pennell, Contr. U.S. Nat. Herb. **20:** 340. 1920.

Stems 15–20 cm. tall, cinereous-puberulent; leaves linear to linear-oblanceolate, 3–5 cm. long, 3–5 mm. wide, finely canescent, entire; calyx-lobes linear-lanceolate, 8 mm. long; corolla 12 mm. long, 5 mm. broad at throat, probably purplish blue, internally not glandular, the throat moderately ampliate, the limb spreading, the lower lip pilose at base; anther-sacs widely divaricate, dehiscent quite to proximal apices, not explanate; staminode scarcely exserted, dilated apically, densely bearded for almost its entire length with long yellow hairs.

Known only from the type collection, made at Mancos, Montezuma County, Colorado, July, 1890, by Alice Eastwood, which I have seen in the U. S. National Herbarium.

This species remains obscure. Additional collections have not been forthcoming despite the fact that much collecting has been done in Montezuma County in the years following Miss Eastwood's original collection and Pennell's description of the species. That it is a rare endemic and not a random introduction of some species from a distant area seems certain,

because its nearest known relative is the Coloradan *P. auriberbis* Pennell, a species that differs in several features.

Pennell did not note that all the upper leaves of the type specimen are ternate, while the several basal pairs are alternate. If this should prove to be a specific character, it would be a material aid in quickly identifying *P. parviflorus*, for no other species of this subgenus has ternate leaves. But as there is only one specimen preserved at present, we are unable to ascertain whether this will prove to be a constant feature of the species or a unique occurrence. If the latter proves to be the case, or if the species cannot be rediscovered, the possibility must be considered that a seed of *P. auriberbis* was accidentally distributed to Montezuma County of a genetically aberrant constitution, so that it sprouted into a plant that flowered without developing a basal rosette, and that had ternate upper leaves and flowers of less than two-thirds the normal size.

7. PENSTEMON JAMESII Benth.

Penstemon Jamesii Benth, in DC., Prod. **10:** 325. 1846.

Stems 1–4.5 dm. tall, glabrate to pubescent below, always glandular-pubescent above; leaves linear to oblanceolate, 2–10 cm. long, 2–10 mm. wide, entire or sometimes undulately serrate, glabrous or puberulent; calyx-lobes narrowly to broadly lanceolate, acuminate, entirely herbaceous or the margin narrowly scarious; corolla 18–32 mm. long, blue-lavender, the throat broadly ampliate and ventricose; upper lip projecting, glabrous within; lower lip reflexed, usually glandular-pubescent within and prominently bearded with long whitish hairs at orifice, the orifice 9–15 mm. wide, guide lines extending into throat from both lips; anther-sacs widely divaricate, explanate, *ca.* as broad as long; staminode exserted, bearded almost its entire length with long often septate yellow hairs.

Southern Utah to northern Arizona, southwestern Colorado, New Mexico and the mountains of southwestern Texas.

KEY TO SUBSPECIES

Lower lip glandular-pubescent within.
Corolla 25–32 mm. long, 10–15 mm. wide.....7a. *P. J.* subsp. ***typicus***
Corolla 17–22 mm. long, 7–10 mm. wide.....7b. *P. J.* subsp. ***ophianthus***
Lower lip glabrous within; corolla 14–16 mm. long, 5–6.5 mm. wide..7c. *P. J.* subsp. ***breviculus***

7a. **Penstemon Jamesii** subsp. **typicus,** nom. nov.

Penstemon Jamesii Benth., l.c.

P. similis A. Nels., Bull. Torrey Club **25:** 548, 1898. Nelson redescribed this New Mexican species under this name, believing that *P. Jamesii* was the plant of the Red Desert of southwestern Wyoming, which, instead is *P. Cleburnei* Jones. The first number he cites is *Fendler 575*, which was probably collected near Santa Fe.

Eastern New Mexico to southwestern Texas. Type locality: "in montibus Scopulosis (James in itinere Longii!)" The route followed by James' part from the Arkansas River in Colorado near the vicinity of what is now La Junta, was straight south into New Mexico veering easterly to strike the Canadian River in western Texas. Apparently the only portion of New Mexico traversed by the party lies now in Union County and we suspect the type came from there.

NEW MEXICO. Exact station unknown, Long's Expedition, *Dr. James* (NY, type). COLFAX Co.: Vermejo River, *Goodding 18* (CI); Raton, *St. John 72* (GH), *McKelvey 4861* (CI): Ute Park, *Standley 13745* (US); E. of Cimarron, *Wilkens 2456* (Ph). MORA Co.: between Wagon Mound and Las Vegas, *McKelvey 4909* (CI); Mora, *Arsene & Benedict 17168* (Ph). SAN MIGUEL Co.: Pajarila (M); Las Vegas, *Arsene 19413* (Po), *Goodding 17* (CI); San Miguel, *Fendler 579* (GH); Arroyo Pecos, *Standley 5168* (US); Las Vegas to Santa Fe, *Osterhout 7032* (Ph); Rowe, *Pringle* (F). SANTA FE Co.: Santa Fe, *Fendler 575* (CI, F, GH, M, NY, Ph, US), *Heller 3605* (GH, M, NY, Po, Pul, SU); Glorieta, *Vasey* (GH,US). SANDOVAL Co.: Placitas (RM); Forest Park, Sandia Mts., *Castetter 1265* (RM); Las Palomas, Sandia Mts., *Ellis 480* (NY). Quay Co.: Tucumcari, *Abbott* (CM). LINCOLN Co.: Lincoln, *Earle 653* (NY); W. of Hondo, *Wilkins 2122* (Ph). OTERO Co.: Highrolls (CI, Ph); Nogal Canyon, Sacramento Mts. (CI). EDDY Co.: Carlsbad Caverns, *Nelson 11408* (C, RM); Queen, *Standley 40687* (US); Guadalupe Mts., near Three Forks of Rocky Arroyo, *Wilkins 1855* (Ph); Last Chance Canyon, *Wilkens 1913* (Ph). TEXAS. PARMER Co.: Farwell, *McKelvey 2770* (Ph). CULBERSON Co.: Pine Canyon, Guadalupe Mts., *Chase 5994* (US); Van Horn's Wells, *Thurber 570* (NY). JEFF DAVIS Co.: Fort Davis, *Jones 25601* (Po). BREWSTER Co.: Alpine, *Palmer 30564* (Ph); 5 mi. W. of Alpine, *McKelvey 1986* (Ph).

7b. **Penstemon Jamesii** subsp. **ophianthus** (Pennell), comb. nov.

Penstemon ophianthus Pennell, Contr. U.S. Nat. Herb. **20:** 343. 1920.

P. pilosigulatus A. Nels., Univ. Wyom. Pub. Bot. **1:** 130. 1926. "This also was secured near Flagstaff, Arizona and is reported by *Mr. Hanson* from 'the Canadian zone and above.' His no. 554, June 6, 1923, is the type." The type is characteristic of much material from northern Arizona which develops a compact rosette of rather short, narrow leaves from which the flowering stem, with its well spaced and linear leaves, emerges. However, gradations are numerous to forms with more ample foliage such as the type of *P. Jamesii ophianthus* has, and these obscure a true regional difference among the races of this subspecies.

Western Colorado and southern Utah southward to western New Mexico and northern Arizona. Type locality: "Thurber, Utah."

COLORADO. Montrose Co.: Naturita, *Payson 347* (CM, F, GH, M, Pul, RM). UTAH. Wayne Co.: Thurber, *Jones 5708* (US, type; isotypes M, NY, Po); Bicknell, *Cottam 4509* (Ph). Garfield Co.: *Siler* (M); Pleasant Creek Camp, *Dixon 286* (RM). Washington Co.: Chadwick's above St. George, April 1913, *Johnson* (Po, a poor, atypical specimen, possibly distinct). NEW MEXICO. ? Co.: between Gallup and Albuquerque, *McKelvey 2336* (GH, Ph, Po). McKinley Co.: W. of Gallup, *McKelvey 4593* (CI); Fort Defiance, *Palmer 108* (NY). Valencia Co.: San Mateo, Mount Taylor, *Castetter 1794* (RM). Sandoval Co.: Sandia Mts., *Ellis 374* (NY, US). Socorro Co.: Santa Magdalena Mts., *Vasey* (GH, US); Magdalena, *Herrick 652* (US). Catron Co.: W. of Patterson, *Wooton* (US). ARIZONA. Mohave Co.: Sturgenegger Ranch, *Cottam et al. 4164* (Ph). Coconino Co.: Red Butte, *Ward* (US); El Tovar, Grand Canyon, *Eastwood 5661* (CAS); 10 mi. S. of Grand Canyon, *Ward* (NY); Grand Canyon-Flagstaff, *Ferris & Duncan 2281* (CAS, M, NY, SU); Williams, *Jones* (Po); San Francisco Peak, *Purpus 7074* (C, M, Po, US); Flagstaff, *Hanson 554* (RM, type of *P. pilosigulatus;* isotype M), *MacDougal 130* (C, GH, NY, Ph, RM, US); 8 mi. E. of Flagstaff (CI, Ph); 15 mi. E. of Flagstaff (M, NY, Ph). Yavapai Co.: Ash Fork, *Jones 94* (C, GH). Navajo Co.: Cedar Springs, *Toumey 368* (SU, US); Taylor (US); Pinedale, *Zuck* (US). Greenlee Co. (?): San Francisco Mts., July 1, 1892, *Wooton* (NY, US).

7c. **Penstemon Jamesii** subsp. **breviculus,** subsp. nov.

Corollis 14–16 mm. longis 5–6.5 mm. latis fere tubulosis haud glandulosis intus, ceteroqui subsp. typicus similibus.

Type: *Baker, Earle & Tracy 410*, collected on dry plains below Mancos, Montezuma County, Colorado, July 8, 1898, Pomona College Herbarium, number 7232. Isotypes CI, F, GH, M, NY, Ph, US.

COLORADO. Montezuma Co.: E. of Cortez, *McKelvey 4640* (CI). NEW MEXICO. San Juan Co.: Aztec, *Baker 601* (GH, M, NY, Po, RM, US); Chuska, *Marsh 102* (US).

Possibly careful field study would demonstrate that this unit is fully deserving of specific rank. On the present data, however, it appears to compose a natural subspecies, the small, scarcely inflated corollas, without glands within the limb or throat, being a constant characteristic of the collections cited and differing appreciably from all others in the species. Pennell cited the type collection under his *P. ophianthus*, but the two do not overlap in corolla-size. It is true that the type collection of *P. ophianthus*, and *Payson 347*, from Naturita, Colorado, both from the periphery of the subspecies and not typical of the unit, have very few glands within

the lower lip; but normally *P. Jamesii* subsp. *ophianthus* is obviously glandular on the lower lip.

It became necessary to reduce *P. ophianthus* to subspecific rank after studying many collections from New Mexico, because subsp. *typicus* contains much variation even within so restricted a region as Santa Fe County. The variable characters include first of all flower-size and the amount of inflation in the throat, then leaf-shape, serration or non-serration of the margin, sepal-length, height of plant, compactness of the inflorescence, etc. There is about as much variation within neighboring races of subsp. *typicus* as between some of them and subsp. *ophianthus*. The range of *typicus* merges with that of *ophianthus* and no evident break in the morphology of the forms across an east to west transect has been discovered. Nevertheless, two excellent subspecies exist that roughly divide the bulk of the species into eastern and western halves, while subsp. *breviculus* forms a marginal island in the general distribution whose members may owe their unique character to an early contact with some other species of the section.

8. PENSTEMON MOFFATII Eastw.

Penstemon Moffatii Eastw., Zoe **4**: 9. 1893.

Stems 1–3 dm. tall, puberulent; leaves entire or essentially so, puberulent, basal with linear-oblanceolate to elliptic blades, cauline linear-oblong; calyx-lobes acuminate, glandular-pubescent; corolla 12–22. mm. long, blue-purple (?), neither glandular nor pubescent within or sometimes sparingly pilose at base of lower lip; anther-sacs widely divaricate, dehiscent throughout but not explanate; staminode mostly included, moderately dilated apically, with a moderate yellow beard along its outer half.

KEY TO SUBSPECIES

Corolla 15–22 mm. long, throat ample.
Blades of basal leaves narrowly ovate to elliptic; upper cauline leaves ± cordate-clasping at base ..... 8a. *P. M.* subsp. *typicus*
Blades of basal leaves oblanceolate; upper cauline leaves not widest at sessile base ..... 8b. *P. M.* subsp. *Paysonii*
Corolla 10–12 mm. long, very narrow; blades of basal leaves oblanceolate ..... 8c. *P. M.* subsp. *Marcusii*

8a. **Penstemon Moffatii** subsp. **typicus,** nom. nov.

Penstemon Moffatii Eastw., l.c.

Central Utah to western Colorado. Type locality: Grand Junction, Colorado.

UTAH. UTAH CO.: Thistle, *Jones* (GH, NY, SU). DUCHESNE CO.: Duchesne (Theodore), *Jones* (Po). GRAND CO.: Thompson's Springs (Thompsons), *Jones* (C, CAS, F, GH, M, NY, Po, RM, SU, US). COLO-

RADO. MESA CO.: Mack, *Jones* (Po); Grand Junction, May 1892, *Eastwood* (CAS, type; isotypes C, GH, M, US), May 1891, *Eastwood* (M, NY, SU), *Pennell 6173* (F, GH, NY, RM, US), Gunnison Mesa, Grand Junction, *Eastwood 5100* (CAS, SU); 7 mi. S.E. of Grand Junction, *Keck 802* (CI); De Beque, *Osterhout 4249* (Ph), *4482* (NY).

8b. **Penstemon Moffatii** subsp. **Paysonii** (Pennell), comb. nov.

Penstemon Paysonii Pennell, Contr. U.S. Nat. Herb. **20**: 342. 1920.

Montrose County, Colorado. Type locality: Naturita.

COLORADO. MONTROSE CO.: Naturita, *Payson 257* (M, type; isotypes F, GH, CM, Minn, RM), *990* (RM), *3864* (C, GH, M, Ph, RM).

8c. **Penstemon Moffatii** subsp. **Marcusii,** nom. nov.

Penstemon pseudohumilis Jones, Contr. West. Bot. **12**: 65. 1908; not Rydb., Mem. N. Y. Bot. Gard. **1**: 347. 1900.

Carbon County, Utah. Type locality: Price.

UTAH. CARBON CO.: Price, June 29, 1898, *Marcus E. Jones* (Po, type), June 20, 1898, *Stokes* (C).

This species has a rather discontinuous distribution over one of the less well known regions botanically. Consequently it is not easy to properly evaluate the importance of the considerable variation in flower-length that may be as great as 4 to 5 mm. from single localities such as Thompsons, Grand Junction and Naturita. Considering the high aridity of the region during much of the year, such variations may principally be due to modification alone. At all events, the local variability greatly decreases the importance of this character which was the chief one advanced in support of *Paysonii* as a species. Also, subspp. *Paysonii* and *Marcusii* are very similar in foliage characters although they are far apart geographically and a portion of the range of subsp. *typicus* intervenes between them. Such recombinations of characters speak for the phylogenetic unity of the species.

9. PENSTEMON DOLIUS Jones ex Pennell

Penstemon dolius M. E. Jones ex Pennell, Contr. U. S. Nat. Herb. **20**: 341. 1920.

Stems 5–15 cm. tall, cinereous-puberulent; leaves entire, densely cinereous-puberulent throughout, basal with lanceolate to elliptic blades, upper cauline linear-lanceolate, narrowed to a petiole-like base; inflorescence scarcely viscid; calyx-lobes linear-lanceolate, acuminate, densely puberulent with a few gland-tipped hairs interspersed; corolla 15–20 mm. long, 4–6 mm. broad at throat, blue-purple, glabrous within or sometimes sparingly pilose at base of lower lip; anther-sacs widely divaricate, dehiscent throughout but not ex-

planate; staminode included, moderately dilated apically, with a sparse to moderate yellow beard along its outer half; capsule glabrous.

Upper Sonoran Zone, from 5,000 to 7,300 ft. elevation, in heavy soils from Elko County, Nevada, to Duchesne and Sevier counties, Utah. Type locality: "Willow Springs, Nevada." Personal communication from Jones locates this as Willow Springs Pass, Deep Creek Mts. (E. flank of the Ibapah Mts.), west of Troutcreek, Juab County, Utah, not far east of the Nevada state line.

NEVADA. ELKO CO.: Ferguson Spring, June 14, 1900, *Jones* (Po); Cobre, June 26, 1907, *Jones* (Po). WHITE PINE CO.: Aurum, May 30, 1893, *Jones* (Po). UTAH. TOOELE CO.: Deep Creek (=Ibapah, acc. M.E.J.), June 6, 1891, *Jones* (Po), June 3, 1917, *Jones* (Po); Clifton, June 19, 1891, *Jones* (Po). JUAB CO.: Willow Spring Pass, June 5, 1891, *Jones* (US, type; isotypes C, CAS, CI, GH, M, NY, Po). SEVIER CO.: 3 mi. N. of Redmond, *Eggleston 11130* (US); Vermilion, June 4, 1901, *Jones* (Po). DUCHESNE CO.: Duchesne (Theodore), May 12, 1908, *Jones* (Po), May 14, 1908, *Jones* (Po); Duchesne (Theodore) to Myton, May 19, 1908, *Jones* (CI, M, NY, Po, SU, US).

10. PENSTEMON PUMILUS Nuttall

Penstemon pumilus Nutt., Jour. Acad. Phila. **7:** 46. 1834.

Stems several from the branching root-crown surmounting a praemorse rootstock, 5–12 cm. tall, cinereous-pubescent throughout; leaves linear to linear-oblanceolate or narrowly spatulate, 15–25 mm. long, 2–5 mm. wide, obtuse or acute, entire, all narrowed to base; inflorescence scarcely viscid, abbreviated; calyx 6–7 mm. high, the lobes acuminate, puberulent with fine gland-tipped hairs interspersed; corolla 14–20 mm. long, 4–6 mm. broad at throat, blue-violet, sparingly glandular-puberulent without, glabrous within; anther-sacs divaricate, dehiscent throughout but not explanate; staminode included, with moderate beard of short yellow hairs almost throughout its length.

Infrequent in the valleys of the upper Salmon and Little Lost rivers, Idaho, at 1500–1900 m. elevation. Type: "On the borders of Little Goddin river, near the sources of the Columbia river. Flowering in June." Wyeth knew the Little Lost River as the Little Goddin River.

IDAHO. CUSTER CO.: 7 mi. up Morgan Creek, *Pennell 15274* (CI, Ph); Challis, *Macbride & Payson 3211* (GH, M, RM). BUTTE CO.: Little Goddin River (Little Lost River), *Wyeth* (British Museum, type, the label bearing the additional information "dry soil nr. a brook"; phototypes C, CI, GH, SU; isotypes GH, NY, Ph); 3 mi. N. of Howe, *Pennell 15190* (CI, Ph); 5 mi. NW. of Howe, *Pennell 15195* (CI, Ph).

The type collection is the only one I have seen in good flower. However,

old flowers on the two collections from Custer County appear to have been no longer than 10–14 mm., whereas those on the type range in length from 16–20 mm. Inadequate material at present prevents me from stating whether this species is variable in flower-size merely at random or in definite geographic directions.

Penstemon pumilus grows in the same region with *P. Whitedii* subsp. *tristis*, but is readily distinguishable by its glabrous capsule, sparingly bearded staminode, small less divergent anther-cells, canescent herbage, and by its finer, shorter, gland-tipped hairs on the calyx.

The closely allied *P. dolius* of Utah and eastern Nevada is separable from *P. pumilus* by its broader leaves and its longer and narrower sepals, but the two apparently are of common origin.

11. PENSTEMON MONOENSIS Heller

Penstemon monoensis Heller, Muhlenbergia **2**: 246. 1906.

P. divergens Jones, Contr. West. Bot. **12**: 64, 1908. Type locality: "Bishop, Owen's Valley, California, 5000 feet altitude, May 15, 1897 [M. E. Jones]."

Stems 15–35 cm. tall, densely cinereous-puberulent; leaves entire, the margin often crisped, densely scurfy puberulent, large, the basal with lance-oblong to broadly oval blades, the cauline narrowly elliptic below to deltoid-ovate and broadly clasping above; calyx-lobes acuminate, viscid-pubescent; corolla 14–18 or 20 mm. long, 4–6 mm. broad at throat, "rose-purple" or "wine-red," not marked with guide lines, glabrous and glandless within or sometimes sparingly pilose at base of lower lip; anther-sacs divergent, dehiscent quite to proximal apices, not explanate; staminode not reaching to orifice, not dilated, strongly bearded for its outer half with fine rather short yellow hairs; capsule glabrous.

Occasional on the desert ranges bordering Owens Valley, California, at elevations of 1400–1600 meters. Type locality: "The type is no. 8331 [Heller], collected May 25, 1906, in the extreme southern part of Mono County, California, along the base of the White Mountains near the Southern Belle Mine."

CALIFORNIA. MONO CO.: Coldwater Canyon, White Mts., May 1913, *K. Brandegee* (C); near Southern Belle Mine (Inyo Co.), *Heller 8331* (C, F, GH, M, NY, Ph, SU, US, isotypes). INYO CO.: Bishop, May 15, 1897, *Jones* (Po, type of *P. divergens;* isotypes C, M, US); Lee Mine, Hunter Ranch Mts., *Austin 526* (C, NY); 15 mi. N. of Darwin, *Hall & Chandler 7176* (C, GH, Po, SU); 2 mi. W. of Darwin, *Munz 12490* (C, F, M, Po, SU); Darwin, *Hall & Chandler 7104* (C, M).

12. PENSTEMON CALCAREUS Brandegee

Penstemon calcareus Brandegee, Zoe **5**: 152. 1903; not Jones, 1908.

P. desertorum Jones, Contr. West. Bot. **12**: 59. 1908. Type locality: "This grows in clefts of the rocks, at 4000 feet altitude, in the Tropical Life Zone at Kelso, California, May 2, 1906 [Jones]." This is on the west slope of the Providence Mountains. Cf. Munz & Johnston, Bull. Torrey Club **49**: 42. 1922.

Stems 5–25 cm tall, densely pruinose-puberulent, anthocyanous; leaves entire or some of them remotely and obscurely denticulate, densely puberulent on both surfaces to glabrate on the lower side, basal with elliptic to broadly ovate blades 15–40 mm long, cauline linear- to oblong-lanceolate, those subtending the inflorescence often subcordate-amplexicaul; calyx-lobes anthocyanous, narrowly lanceolate, viscid-pilose, accrescent; corolla 12–17 mm long, 2.5–4 mm broad at throat, light rose-red to rose-purple, not marked with guide lines nor glandular within, sparingly pilose at base of lower lip, the limb equally 5-lobed; stamens short; anther-sacs widely divaricate, very small, almost as broad as long, explanate; staminode included, not dilated, strongly bearded for $\frac{2}{3}$ its length with rather coarse golden-yellow hairs; capsule glabrous.

Localized in the Grapevine Mountains, at the north end of Death Valley, and in the Providence Mountains, Mohave Desert, California, at elevations of 1200–1800 meters. Type locality: " . . . the face of perpendicular limestone cliffs of Providence Mt."

CALIFORNIA. Inyo Co.: Titus Canyon, Grapevine Mts., May 31, 1935, *Gilman* (Po); Leadfield, Grapevine Mts., 5000 ft., *Gilman 2361* (Po), ditto, 6000 ft., *Gilman 2384* (CI, Po), ditto, *1109* (US). San Bernardino CO.: Providence Mts., May 27, 1902, *T. S. Brandegee* (C, type; isotype C); Bonanza King Mine, *Munz, Johnston & Harwood 4154* (Po, RM, SU, US); Kelso, May 2, 1906, *Jones* (Po, type of *P. desertorum;* isotypes C, Ph).

The desert mountain ranges in which this species has been found are about 160 miles apart and it might be wondered that a species of so limited a distribution, so ruthless an environment and so little opportunity for migration had not produced a recognizably distinct race at each center of its distribution. As a matter of fact, the first collection that came to my notice from the Grapevine Mts., namely the Titus Canyon specimen, differed from the Providence material in having greener leaves, narrower corollas, longer stamens, anther-cells of different shape and a hooked staminode with shorter beard. Subsequent collections from the Grapevines, however, have minimized or reversed these differences with the exception that in all, the leaves have less puberulence and the staminode has a shorter beard. It is well known that the desert environment may effect wide modifications in the same plant from one season to the next. In this species, as yet relatively poorly collected and in which considerable variability has been noted to occur in the floral structures at one locality, there can be but

little justification at present for stressing the minor morphological differences that happen to coincide with the geographical.

The discovery of *P. calcareus* in the Grapevine Mts. brings its known range much closer to that of *P. monoensis*, the other reddish flowered Californian member of this section. The two species share many features in common and are surely very closely related, but a number of qualitative differences separate them. *Penstemon monoensis* has a larger and somewhat ventricose corolla, minutely denticulate-ciliate anther-cells that are not explanate and of more than twice the length, and a more densely and softly bearded staminode.

13. PENSTEMON MISER A. Gray

Penstemon miser A. Gray, Syn. Fl. **2**(1): 441. 1886.

Stems 10–25 cm tall, cinereous-puberulent; leaves mostly entire, some remotely serrulate or sinuately toothed, densely cinereous-puberulent throughout, basal with linear-lanceolate to elliptic blades, upper cauline linear to oblong; calyx-lobes acuminate, strongly glandular-pubescent, not puberulent, variable in size; corolla markedly variable, 13–28 mm long, 4.5–10 mm wide (!), dull lavender, purple guide lines within throat, not glandular within, strongly pilose with yellow-white hairs at base of lower lip; anther-sacs widely divaricate, very small, as broad as long, explanate or nearly so; staminode exserted, not dilated, strongly bearded for its entire length with stiffish deep orange hairs; capsule glabrous.

Malheur County, Oregon, southward to central Nevada and northeastern California, at elevations of 900 to 2200 meters. Type locality: "Eastern Oregon, along the Malheur River, *Cusick*."

OREGON. MALHEUR CO.: sterile soils of the Malheur (River), *Cusick 1239* (GH, type; isotypes Ph, US); Malheur Valley near Harper Ranch, *Leiberg 2226* (C, GH, NY, US). HARNEY CO.: East base of Stein's Mt., May 30, *Train* (Oberlin). CALIFORNIA. MODOC CO.: 9 mi. W. of Alturas, near Pitt River, *Applegate 869* (SU, US). LASSEN CO.: top of Diamond Mt., Susanville, Perkin's Ranch, June 28, 1897, *Jones* (Po). NEVADA. ELKO CO.: E. of Wells, *Eastwood & Howell 317* (CAS, CI); 8 mi. S. of Wells, *Keck 921* (CI, SU); Sprucemont, July 21, 1891, *Jones* (Po); Overland Pass, Ruby Mts., *Mason 4823* (CI). WHITE PINE CO.: 7 mi. S.W. of Ely, *Keck 616* (CI, SU). NYE CO.: 4.8 mi. E. of Currant at White Pine County line, *Keck 605* (C, CAS, CI, GH, M, NY, Ph, Po, Pul, SU, US); S. Twin River, June 8, 1933, *Goddard* (C, CI). EUREKA CO.: Eureka, *Kennedy 845* (RM); Robert's Station, Monitor Valley, *Watson 778* (GH, NY, US).

The variability in flower-size in *P. miser* is perplexing. Material from

Malheur Co., Oregon, is relatively small-flowered (15 mm. long, 5–6 mm. wide), with a gradually ampliate but narrow throat; that from Harney Co. is appreciably larger in this respect, while in that from Modoc Co., California, it is half again as long and 9 mm. wide, the ampliate throat flaring abruptly from the narrow tube. In eastern Nevada the situation is repeated with even more variation. In Elko Co. the collections tend to be rather uniformly larger than the type and more ampliate, but less abruptly ventricose than the Applegate collection from Modoc County. *Keck 605* and *616* are similar with corollas 13–14 mm. long and only 4.5 mm. wide. In startling contrast is the collection from relatively nearby in Nye County, *Goddard*, in which the flowers are 28 mm. or more long and 10 mm. wide! It is determined from an ample number of collections that differences in flower-size run counter to geographic divisions, so we cannot do otherwise on the basis of present evidence than admit these striking variations within the same taxonomic unit. The only other character that is noticeably variable is the shape of basal leaves, which may be nearly linear or almost oval in the same local colony. In other respects this species is quite uniform and there is no indication that it is unnatural.

14. PENSTEMON GRAHAMII Keck

Penstemon Grahamii Keck ap. Graham, Annals Carnegie Mus. **26**: 331. 1937.

Stems few (1–3), erect, from a praemorse fibrous-rooted rootstock, 12–18 cm tall, retrorse-pubescent quite to the base; leaves entire, rarely obscurely toothed, glabrous below the inflorescence or essentially so, coriaceous, prominently reticulate veined, slightly glaucous, dimorphic; basal with lance-ovate to oval blade, the largest of which are 20–35 mm long, 15–20 mm wide, obtuse, with winged petioles half as long; cauline oblong, clasping or subcordate at base, obtuse or acute, very gradually reduced within the inflorescence, the lower pairs ± equaling the flowers; inflorescence glandular-pubescent, composed of 2–6 verticillasters; peduncles nearly erect, stout, 3–5-flowered; calyx 7–9 mm high, accrescent, moderately pubescent with prominent gland-tipped hairs, the lobes lanceolate, merely acute, ± coriaceous, the margin at base narrowly hyaline; corolla 30–35 mm long, 11–12 mm broad at throat, light to deep lavender, lower lip striped with red-purple, glandular-pubescent without, glabrous within except for a sparse beard of white villous hairs across the base of lobes of lower lip; tube narrow, abruptly expanding into a strongly arched throat not as long; limb equaling or exceeding throat, widely gaping, the erect upper lip 10–12 mm long, its lobes ⅓ the length, exceeding the sharply recurved lobes of the lower lip; anthers exceeding orifice, the sacs widely divaricate, explanate, almost as broad as long; staminode exserted, prominently and densely bearded on all sides for its entire length with deep orange flattened hairs 0.5 mm long, not dilated but falcate apically; ovary and capsule glabrous.

Type: Edward H. Graham, no. 7883, Carnegie Museum Herbarium, collected on a talus slope, west side of Green River, south of mouth of Sand Wash, Uintah County, Utah, at 1370 meters altitude, May 27, 1933.

Known from one other collection taken on a bench west of Green River, north of the mouth of Sand Wash, Uintah County, Utah, at the same elevation and date as the type, *Graham 7916* (CM, CI, Ph).

This plant is undoubtedly a very narrow endemic of the Uinta Basin. Not far to the west occurs *P. dolius*, a species with which the present novelty has very little in common; and to the southward is found *P. Moffatii*, likewise but distantly related. It has some habital features in common with *P. Cleburnei*, and a flower-size resemblance with *P. erianthera*, both of which occur well to the northward of it in Wyoming. However, the most distinctive features of *P. Grahamii*, its corolla with peculiar shape and ratio between length of tube and throat, and its staminode, are duplicated only in *P. miser*, which occurs from Nevada westward. The remarkable flower of *P. Grahamii* is found on a smaller scale in the large-flowered forms of *P. miser*, but not elsewhere in this section. Likewise, the falcate staminode, so densely bearded throughout its length with bright orange short hairs, is quite alike in the two species except that in *P. Grahamii* the beard is quite as dense on the lower as on the upper side. Accordingly, in floral characters there is considerable similarity between *P. Grahamii* and *P. miser*, and in vegetative characters, between it and *P. Cleburnei*.

15. PENSTEMON GORMANII Greene

Penstemon Gormanii Greene, Ottawa Naturalist **16**: 39. 1902.

Stems 1–3 dm tall, glabrous below, glandular-pubescent above; leaves entire or sometimes shallowly serrulate apically, basal with narrowly oblanceolate to spatulate blades, acute or obtuse, glabrous, upper cauline lanceolate, those within the inflorescence glandular-pubescent; calyx-lobes acuminate, pilose with gland-tipped hairs; corolla 18–25 mm long, 8–10 mm broad at throat, blue-purple, not glandular within, rather strongly pilose at base of lower lip; anther-sacs widely divaricate, dehiscent throughout but not explanate, longer than broad; staminode slightly exserted, moderately bearded for more than half its length with long yellow hairs; capsule (and ovary) glabrous.

Gravelly or rocky slopes and hillsides in the drainage of the upper Yukon River and Yukon Valley, Yukon Territory and adjacent Alaska. Type locality: "Dry gravelly slopes of hills in Yukon Valley, June 9, 1899. M. W. Gorman."

ALASKA. Chandalar River, approx. 67° N.×147° W., June 1927,

Mertie (F). YUKON TERRITORY. Dry Gulch, Yukon Valley, *Gorman 1011* (US, type; isotype NY); Fifty Mile River, June 28, 1899, *Bolton* (Ph, US); Dawson, *Anderson 1898* (NY), 1916, *Kusche* (GH), *Beauchamp Expedition 82* (C), *Eastwood 284* (CAS, GH, Po); banks of Klondyke, Aug. 1898–1901, *MacLean* (C, GH, Po); Five Finger Rapids, Aug. 21, 1899, *Williams* (NY), *Tarleton 50b* (NY); Lake Laberge, *Tarleton 50a* (NY); White Horse Rapids, July 13, 1930, *Setchell & Parks* (C, CAS); Carcross, *Eastwood 690* (GH); Bear Creek, Lake Dezadeash, Aug. 6, 1920, *Müller* (Ph); Lake Noris (?), hear head of Yukon River, *Schwalka 66* (GH).

16. PENSTEMON ERIANTHERUS Pursh

Penstemon eriantherus Pursh, Fl. Am. Sept. **2**: 737. 1814.

P. cristatus Nutt., Gen. Pl. **2**: 52. 1818. Type locality: Missouri River, in the present state of South Dakota.

Chelone erianthera Steud., Nom. Bot. 186. 1820–4.

C. cristata Spreng., Syst. Veg. **2**: 813. 1825.

Penstemon saliens Rydb., Mem. N. Y. Bot. Gard. **1**: 344. 1900. Type locality: Columbia Falls, Montana.

P. eriantherus subsp. *saliens* Pennell, Contr. U.S. Nat. Herb. **20**: 343. 1920.

Stems 1–3 dm tall, villous to canescent; leaves entire to saliently and remotely toothed, glandular-pubescent to canescent, basal with lanceolate to ovate blades, upper cauline lanceolate to oblong; calyx-lobes acuminate, strongly viscid-pubescent; corolla 20–35 mm long, 9–14 mm broad at throat, "light blue-magenta" or "purplish violet," guide lines of deeper color within throat, not glandular within, or somewhat glandular-pubescent on particularly the lateral lobes of lower lip, strongly pilose at base of lower lip; anther-sacs widely divaricate, explanate or nearly so, as long as wide or somewhat longer than wide, with broad line of contact; staminode prominently exserted, strongly bearded throughout its length with long yellow septate hairs; capsule (and ovary) glandular-puberulent.

Western North Dakota, South Dakota and Nebraska, westward throughout Montana and all but southwestern Wyoming to Spokane Co., Washington, avoiding Idaho by way of southern Alberta and British Columbia. Type locality: "In upper Louisiana, Bradbury . . . " According to Pennell, this was taken along the Missouri River in the present state of South Dakota.

This species has been mapped and citations made of its distribution by Pennell,[1] so I am confining citations here to a list of counties from which I have seen material, with full citation in the northwestern portion of the range that Pennell did not treat.

[1] Pennell, F. W.: Monograph I. Acad. Nat. Sci. Phila. 256. 1935, as *P. cristatus*.

NORTH DAKOTA: Mercer, Morton, Grant, Stark, Billings, Slope. SOUTH DAKOTA: Campbell, Hughes, Stanley, Mellette, Corson, Meade, Butte, Pennington, Custer. NEBRASKA: Thomas, Dawes, Morrill, Sioux. COLORADO: Weld. WYOMING: Weston, Niobrara, Goshen, Laramie, Converse, Albany, Carbon, Sheridan, Big Horn, Park, Yellowstone Nat'l Park. MONTANA: Dawson, Judith Basin, Carbon, Stillwater, Sweet Grass, Cascade, Meagher, Park, Gallatin, Lewis and Clark, Jefferson, Madison; GLACIER Co.: Midvale, *Umbach 140* (F, NY, SU, US). POWELL Co.: Deer Lodge Valley, 1906, *Jones* (Po). DEERLODGE Co.: Anaconda, 1905, *Jones* (Po). BEAVERHEAD Co.: Lima, 1908, *Jones* (Po); Monida, 1908, *Jones* (Po). FLATHEAD Co.: Columbia Falls, *Kennedy 53* (NY, type of *P. saliens*), *Williams 126* (US); Kalispell, *Wilcox 369* (NY). MISSOULA Co.: Missoula, *Kirkwood 1390* (C, CAS, CI, F, Ph). LINCOLN Co.: Tobacco Mts., *Butler 5043* (NY). ALBERTA: Macleod, 1913, *Moodie* (US); Crows Nest District, Castle River Forest Station, *Brinkman 3087* (NY). BRITISH COLUMBIA: Fort Steele, *Anderson 6245* (NY, Pul); Fairmont Hot Springs, *Sanson 1009* (NY); Cranbrook, 1915, *Garrett* (NY). WASHINGTON: SPOKANE Co.: Spokane Falls, *Leiberg 28* (GH); Spokane, *Kilburge 873* (CI); between Spokane and Marshall, *Suksdorf 9009b* (Ph); Waikiki, 1913, *Turesson* (RM).

A species of so wide a distribution not unnaturally displays considerable variation. This affects many of the prominent characters including size of the plant as a whole and of its various parts individually, pubescence, leaf-shape, flower-color, bearding within the corolla, degree of explanation in the anther-cells and their shape, etc. Were two or more of these variables to become fixed over a portion of the range of *P. erianthera*, thereby establishing a recognizable geographic unit, it would be desirable to name such a unit.

As this goes to press I learn that careful field studies during the past summer by Dr. F. W. Pennell have disclosed the occurrence of two races in western Montana that differ appreciably from each other and that stand out from other forms in this variable species because each occurs over a considerable area to the exclusion of other races.

In the vicinity of Bozeman, many collections were made of a race in which the flowers attain maximum size for the species. Apparently most, if not all, of the material from Gallatin County is assignable to this unit. It may be designated var. **grandis** Pennell et Keck, var. nov., foliis caulinis usque ad 70 mm. longis, 12 mm. latis; corolla 30–42 mm. longa latissime campanulato-ampliata. Type: *F. W. Pennell & F. B. Cotner 20511* (Ph), from black soil over limestone, 5800–6000 ft. alt., divide between Rocky and Bridger Mts., east of Bozeman.

In Beaverhead County, a low, small-flowered form with narrowly linear cauline leaves occurs exclusively. This is var. **redactus** Pennell et Keck, var. nov., foliis caulinis usque ad 65 mm. longis 6 mm. latis; corolla 18–24 mm. longa, ore hiante. Type: *F. W. Pennell 20605* (Ph), from gravelly and stony slopes, 7100–7200 ft. alt., south-east of Sawyer, along Bear Creek, Beaverhead Mts., 16 miles east of Monida, June 28, 1937. Pennell also collected this at Lima and the material cited above from Beaverhead County is also assignable to this variety.

The type of *P. saliens* Rydb. is a specimen with unusual leaf-shape and toothing not shared by other collections from that region. To attempt to expand that concept to include all materials from western Montana northwestward leads into serious difficulties, for one must depend upon leaf characters in some cases, on flower-size in others and purely on geographic location elsewhere as, for instance, in Missoula Co., Montana. Thus, I believe that for practical considerations this species must be treated rather broadly. Sufficient detail must still be observed to satisfactorily separate *P. Whitedii* and its subspecies from *P. eriantherus*, but there the line seems to mark closely related ecospecies.

17. PENSTEMON CLEBURNEI Jones

Penstemon Cleburnei M. E. Jones, Contr. West. Bot. **12:** 62. 1908.

P. auricomus A. Nels. ex Rydb., Bull. Torrey Club **36:** 688. 1909. "*Penstemon Jamesii* A. Nelson, Bull. Torrey Club **25:** 547. 1898" (as to description). Type locality: Red Desert of Wyoming.

Stems 1–2 dm tall, pubescent; leaves entire, rarely obsoletely toothed, strigillose, basal with oblanceolate to broadly ovate (up to 4 cm broad) blades, upper cauline linear-oblanceolate to broadly oblong, usually obtuse; calyx-lobes acuminate, viscid-pubescent; corolla 16–25 mm long, 6–9 mm broad at throat, "purple," narrow guide lines at orifice, not glandular within, exceedingly pilose at base of lower lip; anther-sacs widely divaricate, explanate, *ca.* as long as broad, with broad line of contact, staminode slightly exserted, strongly bearded throughout its length with long golden yellow septate hairs; capsule (and ovary) glandular-puberulent.

Red Desert of southwestern Wyoming and to the base of the Uinta Mts. in adjacent Utah. Type locality: "This is common on the Green River Desert, Wyoming, at Granger and Green River, and appears to have been first collected since the time of Nuttall by Cleburne, June 27, 1875. It is also A. Nelson's no. 4716."

WYOMING. CARBON Co.: Hanna, *Payson 1691* (CAS, GH, M, NY, Ph, RM); Ft. Steele, *Nelson 5384* (C, RM); Rawlins, *Keck 915* (CI). FREMONT Co.: 8 mi. W. of Wind River, *Costello & Rawlins 2064* (CI). SWEETWATER Co.: Green River, June 27, 1875, *Cleburne* (Po, type), *Nelson*

3052 (RM, type of *P. auricomus;* isotypes GH, M, NY), *Nelson 4716* (CM, F, NY, Po, Pul, RM); 21 mi. W. of Green River, *Payson & Armstrong 3204* (GH, M, Ph, Po, RM); Granger, June 24, 1896, *Jones* (Po); Burned Fork, *Williams 406* (CAS, NY, RM, Utah). UTAH. DAGGETT Co.: S. of Manila, *Williams 443* (NY).

This species is closely allied with *P. eriantherus* Pursh, the two having many characters in common. The two are separable by the smaller corolla with contracted orifice, more densely pilose lower lip, and shorter, stiffer beard of the staminode in *P. Cleburnei.* This species, for the most part, is lower in stature and has broader rosette leaves than *P. eriantherus*, giving it a somewhat different aspect.

The two species occupy different geographical areas, but in Carbon County, Wyoming, they occur together and there the flowers of *P. Cleburnei* are larger than average. Also, in Big Horn County, Wyoming, a race of *P. eriantherus* is found that simulates *P. Cleburnei* in stature and flower-size, but in it the throat is broader and the staminode longer-bearded. Representative of this race are: 10–15 mi. E. of Kane, *Williams 3012* (CI); near summit of Big Horn Mts., *Ownbey 833* (CI); Trappen Creek, on road from Shell, *Finley 25* (RM).

18. PENSTEMON WHITEDII Piper

Penstemon Whitedii Piper, Bot. Gaz. **22:** 490. 1896.

Stems 1–3 or 4 dm tall, pubescent to glabrate; leaves entire to sharply toothed, glabrous to densely cinereous-puberulent, broadly linear to lanceolate or oblanceolate; calyx-lobes acute to acuminate, strongly viscid-pubescent, not additionally puberulent; corolla 18–23 mm long, 6–9 mm wide at throat, mauve to deep red-purple throughout or the lobes more indigo, guide lines of darker color within throat, not glandular within, ± pilose at base of lower lip; anther-sacs widely divaricate, much longer than broad, not explanate, with short line of contact; staminode scarcely exserted, usually bearded with golden yellow hairs; capsule (and ovary) glandular-puberulent.

Central Washington, northeastern Oregon, and central Idaho.

KEY TO SUBSPECIES

Staminode densely bearded for almost its entire length with hairs much longer than its width.
Upper cauline leaves cordate-clasping at base, mostly 3 to 4 times longer than broad; verticillasters in flower 4.5–6 cm broad ..... 18a. *P. W.* subsp. *typicus*
Upper cauline leaves merely sessile or even narrowed at base, mostly 5 to 8 times longer than broad; verticillasters in flower 2–4 cm broad ..... 18b. *P. W.* subsp. *tristis*
Staminode sparsely bearded with hairs *ca.* equaling its width to glabrate or rarely glabrous .... 18c. *P. W.* subsp. *dayanus*

18a. **Penstemon Whitedii** subsp. **typicus,** nom. nov.

Penstemon Whitedii Piper, l.c.

P. eriantherus var. *Whitedii* A. Nels., Bot. Gaz. **54:** 148. 1912.

Known only from southern Chelan County, Washington. Type locality: "Collected in rocky soil near Wenatchee, Kittitas county [now Chelan County], July 7, 1896. *Kirk Whited* no. 131."

WASHINGTON. CHELAN CO.: Wenatchee, *Whited 131* (US, type; isotype Pul), *1068* (GH, US), *1102* (NY, US), *1166* (US), *1257* (US); lower Blewett Pass, *Thompson 8307* (C, CI, M, NY, Ph, SU).

18b. **Penstemon Whitedii** subsp. **tristis** Pennell et Keck, subsp. nov.

Caulibus spithameis, foliis glaucescentibus angustis, supremis lanceolatis sessilibus, inflorescentia brevi plus minusve cum glandulis roridis, floribus et capsulis in eadem cyma accrescentibus, corolla purpurascente a basi labio infero villosissima, filamento sterili hinc longe denseque barbato.

Type: *F. W. Pennell no. 15200*, collected on a rocky calcareous mountain along Antelope Creek, Custer County, Idaho, at 1890 meters elevation, June 21, 1931, Academy of Natural Sciences of Philadelphia. Isotype CI.

IDAHO. LEMHI CO.: Salmon, *Payson 1838* (CAS, GH, M, NY, RM), *1787* (M, RM); Salmon River, 23 mi. above Salmon, *Pennell 15232* (CI, Ph). CUSTER CO.: Clayton, *Macbride & Payson 3363* (GH, RM); Mackay, *Nelson & Macbride 1421* (GH, M, F, RM), *1562* (RM); Morgan Creek, *Pennell 15246* (CI, Ph). BLAINE CO.: Lost River Mts., near Clyde, *Macbride & Payson 3133* (GH, RM). OREGON. WALLOWA CO.: Imnaha (River), *Cusick 1435* (GH, Ph), *Sherwood 133* (F).

18c. **Penstemon Whitedii** subsp. **dayanus** (Howell), comb. nov.

Penstemon dayanus Howell, Fl. N. W. Am. **1**: 511. 1901.

P. eriantherus var. *argillosus* M. E. Jones, Contr. West. Bot. **12**: 62. 1908. "John Day Valley, Oregon, June 6, 1902, Cusick, No. 2803." Exactly the same form that Howell had previously described.

North-central Oregon, on open dry hillsides in the drainage of the John Day and Deschutes rivers, at elevations of 300 to 1100 meters. Type locality: "Hillsides and plains, Muddy Station, John Day Valley, Oregon."

OREGON. GILLIAM CO.: Pine Creek, *Leiberg 179* (GH, NY, Ph, Po, RM, US). ? CO.: Muddy Station, John Day Valley, May 12, 1885, *Howell* (UOregon, type; isotype GH), the same, May 11, 1885 (Ph, Pul, US); John Day Valley, *Cusick 2803* (Po, type of *P. eriantherus* var. *argillosus;* isotypes C, CI, F, GH, NY, Ph, Pul, Minn, US). WHEELER CO.: 5 mi. N. of Mitchell, *Peck 10091* (F, NY); 4 mi. E. of Mitchell, *Keck & Clausen 3669* (C, CAS, CI, GH, NY, Ph, Po, Pul, SU). CROOK CO.: Crooked River, *Cusick 1672* (C, F, M, US).

The situation in this species is somewhat unusual in that one discerns

here three geographic centers, not very closely approaching each other, and in each of which a recognizable morphological unit has appeared. These I am calling subspecies because in most respects they share common characters that strongly indicate their monophyletic origin and a continuous series of morphological variants links all the forms together. That this continuous chain of forms is geographically divisible into three parts may perhaps either be accounted for by the geological history of the region or by the comparatively modern transplantation of portions of the species into new regions. For instance, subsp. *typicus* appears to have a very restricted range in Chelan County, central Washington. Probably as a consequence, this unit is but little variable. On the other hand, it is very difficult to separate from certain forms of subsp. *tristis*, which occur no closer than the Imnaha River of northeastern Oregon. Furthermore, subspp. *tristis* and *dayanus*, which have more extensive ranges, are appreciably variable and it is this variability which ties the units together. In other words, here appear to be three elements that now possess apparent geographic isolation, but that seemingly lack a comparable structural distinctness.

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INDEX TO AMERICAN BOTANICAL LITERATURE
1934–1937

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

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